SCIENTIFIC AMERICAN

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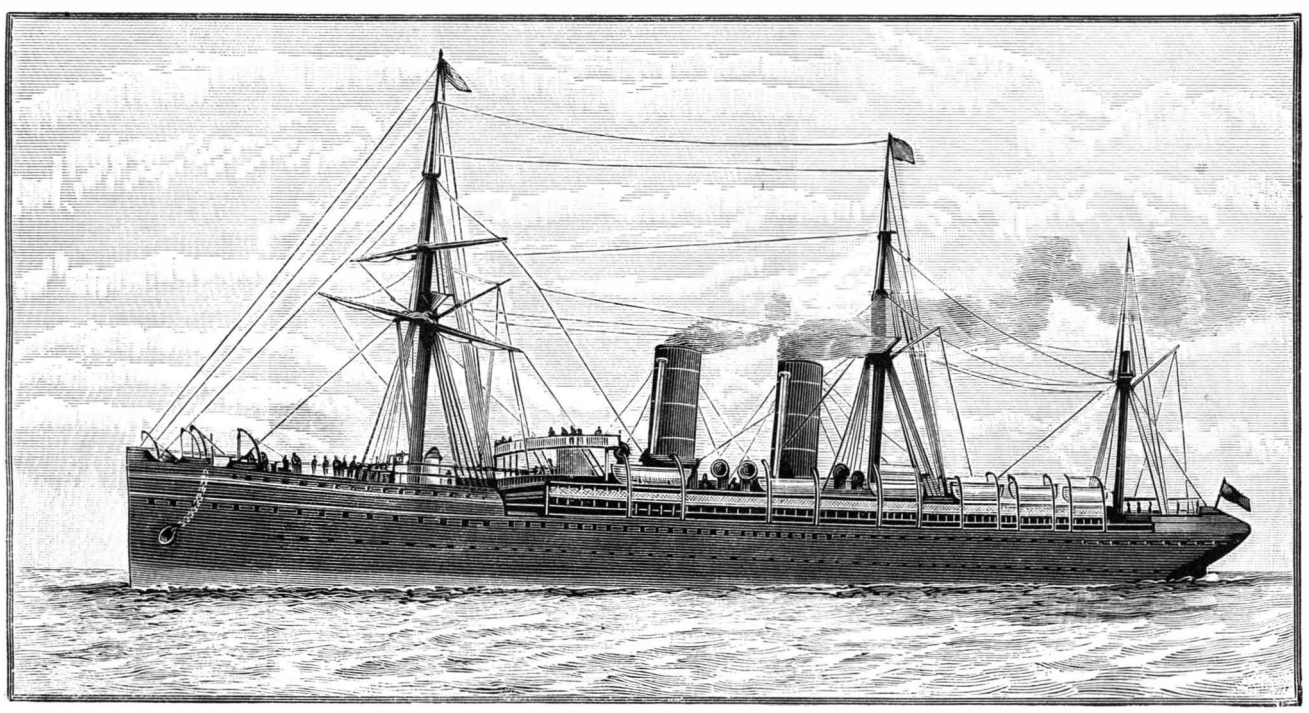

Fig. 1.—THE ROYAL MAIL STEAMER UMBRIA OF THE CUNARD LINE.

Fig. 2.—CAPTAIN McKAY OF THE CUNARD STEAMER UMBRIA.

Captain H. McKay, who commanded the Cunard liner Umbria during her recent eventful voyage, is a native of Stonehaven. He has been in the Cunard service for thirty-one years —during twelve of these as master of some of the finest vessels in the Cunard fleet. He succeeded the late Captain McMickan in his present position as commander of the Umbria.

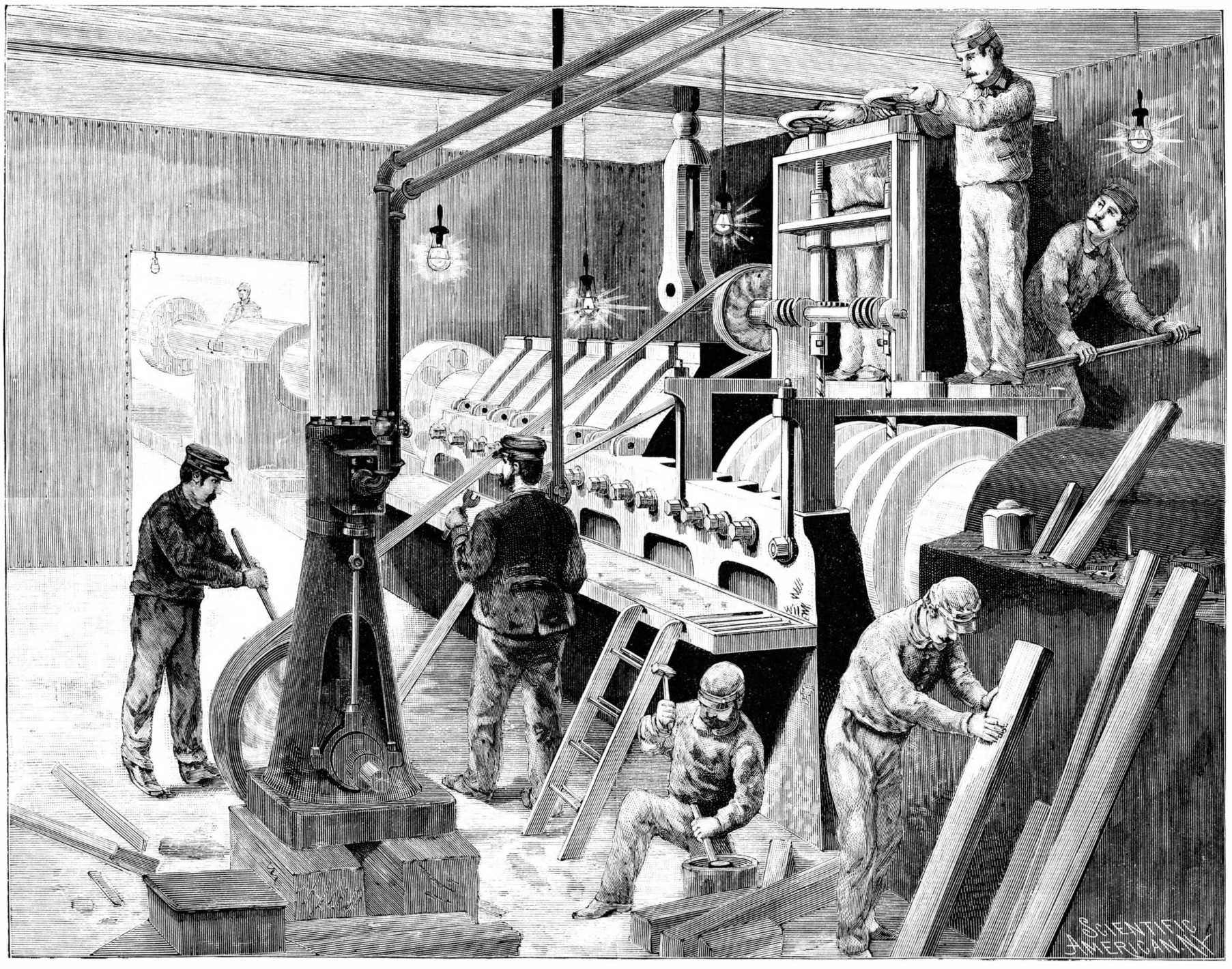

Fig. 3.—THE CUNARD STEAMER UMBRIA—THE SPECIAL DUPLEX DRILLS FOR CUTTING OUT THE BROKEN SECTION OF THE MAIN SHAFT.—[See page 56.]

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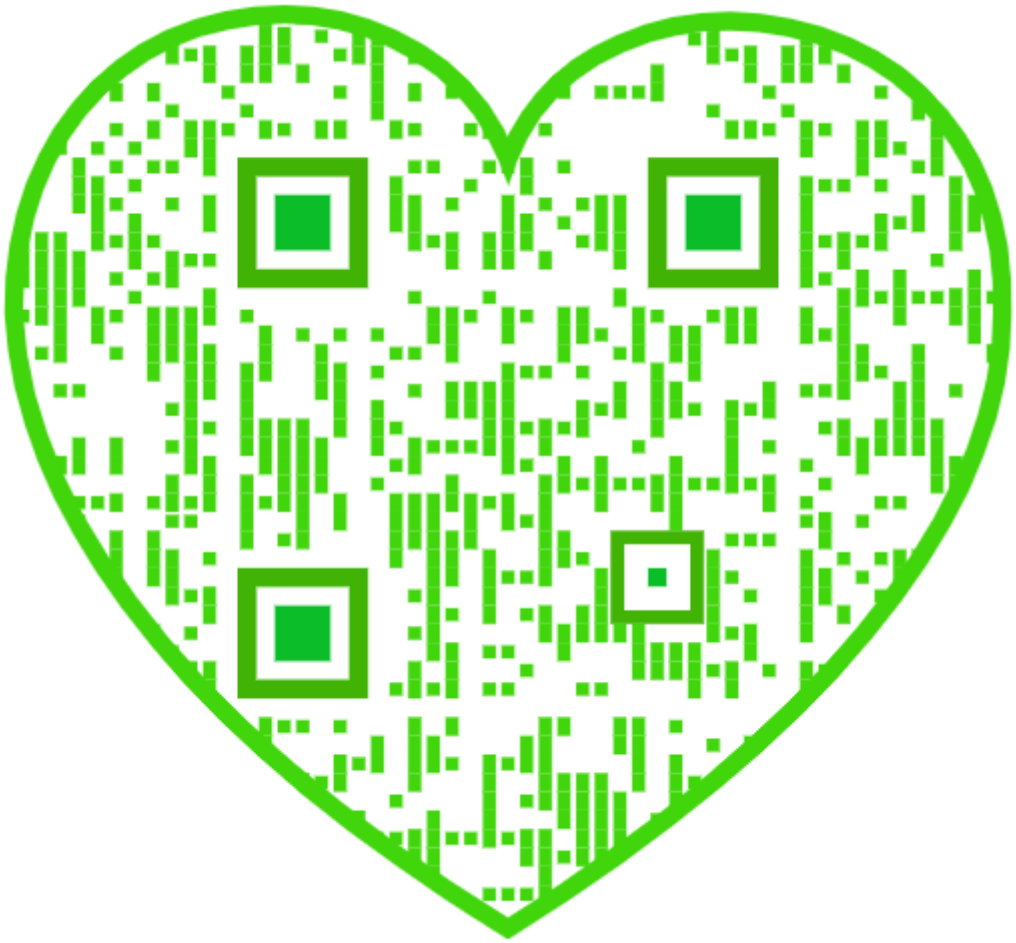

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AMERICAN SOCIETY OF CIVIL ENGINEERS.

The fortieth annual meeting was held January 18 and 19 at the home of the society in New York. The annual reports were made, after which the canvass of votes for officers of the ensuing year was read by the secretary, resulting in the election of Wm. Metcalf, Pittsburg, Pa., president; Charles Macdonald, New York City, and E. L. Corthell, Chicago, vice-presidents; Foster Crowell, Henry G. Prout, Willard S. Pope, F. P. Stearns, J. S. Fanning, and O. H. Landreth, directors; Francis Collingwood, secretary; John Bogert, treasurer.

In the evening an address, with lantern views, was given by Wm. D. Kelley, of Washington, D. C., on his surveys in Ecuador and Peru for the proposed Intercontinental Railway.

On the second day a number of the members visited the improvements on the Harlem River, Macomb's Dam Bridge, and the Viaduct, after which they proceeded to the De la Vergne Refrigerating Machine Co., at Port Morris.

In the evening a reception was held in the rooms of the society, which was largely attended.

PROPOSED ADDITIONS TO THE ELEVATED STEAM STREET RAILWAYS IN NEW YORK.

The legislative commission appointed to consider and establish new and better methods for improving the rapid transit facilities in the city of New York, after many laborious months of study and deliberation, finally settled upon the underground system, and elaborated the general plans for construction and location thereof. The franchise, which was subject to many restrictions, and rendered onerous by the vast amount of capital required, namely fifty millions of dollars, was put up at public auction in December last. No valid bids were offered. Capitalists were unable to see any sure profit in the great work, notwithstanding the fact that almost every other railway within the city limits is a mine of wealth to the owners. All of them, however, run on the ground or above ground.

The fifteen years' experience which New Yorkers have had with the elevated steam railways, and the excellent service they have rendered, seems to have satisfied the people that this is, on the whole, the best method for city rapid transit, although it is attended with many most serious objections, especially for those who live and do business along the railway lines. For them it obstructs the streets, fills them with dirt and dust, produces deafening noise, etc. But these overhead trains are comfortable and satisfactory to the travelers, who constitute a vast host. No railways in the world carry such enormous numbers of passengers as these elevated steam street cars. Their aggregate length is only 34 miles; but they carry nearly 700,000 passengers every day. At the morning and evening hours, when the people go to or return from business, these cars are crowded to excess, and there has been for a long time the most pressing need for relief by the addition of more cars and facilities.

The failure of the commissioners to sell the underground franchise has left them apparently no alternative than to authorize an extension of the elevated system; and this is now under consideration. Several new lines have been laid out, and a number of cross town connections planned, which, when constructed, as they may be within a few months' time, will greatly add to the convenience of the public.

UNCLEAN PAPER MONEY A VEHICLE FOR THE SPREAD OF DISEASE.

A bill has recently been presented in Congress requiring the Secretary of the Treasury to provide for the calling in of all ragged, worn, and soiled paper money, new bills to be furnished in place of the old and unclean notes. It is surprising, when one thinks of it, that some such action has not long ago been taken, for not a little of the paper money daily passing from hand to hand has become extremely repulsive in appearance, and is ever suggestive of disease-spreading power.

In any provision made for the calling in of the old and soiled bills, the banks must, of course, be the principal intermediaries, but they would in most cases be only too glad to substitute new bills for all the old ones which come in over their counters, could sufficient facilities be afforded for obtaining new bills from the Treasury Department. The resolution now before Congress is designed to give a more deserved promi nence to this matter, and it is to be hoped the measure will be promptly adopted.

The origin of disease germs has been the subject of elaborate investigation and experiment by the ablest biologists, and although our knowledge is still largely speculative, much is known about the way in which such germs are "borne about and deposited in soils suitable for their growth and reproduction. That they are present in the atmosphere of a sick-room, carried on particles of dust, and with them attached to the walls of the room, to carpets, to the clothing of passers-in and passers-out, and, indeed, to every absorbent surface; that they are thereafter dispatched on fatal errands by the housemaid's broom and dusting cloth; that they and their encrusted spores, or seed, are capable of lying in what may be termed a dormant condition, certainly for months, on any surface that catches and detains them, unaffected by excesses of temperature; that, released by a brush or a current of air, and dropped in a substance that affords them nourishment, they multiply with incalculable rapidity." These are facts that have been thoroughly demonstrated. That such germs may, and in thousands of cases doubtless do, become attached to the fibers of worn and soiled bank notes, that they may in fact, in some instances, constitute the very matter which gives them their unclean and repulsive appearance, is a proposition which cannot be denied.

The Hydrotype.

M. Cros has devised a kind of reversed collotype, in which a plate coated with bichromated gelatine is exposed under a transparency until the most exposed portions are so acted upon that they refuse to swell in water. The bichromate is now washed out, and the plate is immersed in an aqueous dye, which is absorbed by those parts of the film which have not been hardened by exposure, and so a very perfect and vigorous transparency results. If a sheet of moistened paper be pressed down on the film, a print in the dye or color results, but M. Cros. deals with the matter rather from the point of view of the transparent reproduction. The plate being dried and slightly rinsed, sufficient coloring matter remains on the film. Old plates will give us plain gelatinized glass, if we remove the bromide by the hyposulphite bath, and wash. If the plates have been developed, the image may be removed by the following bath:

Ferricyanide potassium	3 parts
Sodium hyposulphite	10 "
Water	100 "

This solution must be used while fresh. The plates are now sensitized in a three per cent solution of ammonium bichromate, and, after drying, are exposed in the printing frame for about the time that would be required in the case of an ordinary silver print. Thorough washing is now required, followed by a second desiccation. The plate is now stained with an aqueous solution of the coloring matter. Any aniline or other dye soluble in water may be used. It should be noted, says *Photography*, that plates which have been treated with alum are unsuitable for this process, as alum hardens the whole film.

Soap from Cotton Seed Oil.

The following account, given in a communication to the *American Soap Journal*, of how this oil is employed by a practiced soap maker, centains much information upon this point which is of a useful nature. The question of how much soap a given quantity of tallow will make is often a difficult point to gauge. In the following method one of the advantges claimed is that the yield of soap agrees with calculated yield, 180 pounds of fat giving 535 pounds of clear waxy soap. The formula given below has been successfully used for eighteen months:

	Pounds.
Refined cotton seed oil	164
Tallow	16
Resin "K"	75
Silicate of soda "N"	75
Palm oil	1
Caustic lye, 35 deg. B.	153
Starch	3¾
Sal soda	5
Silex	40
Water	1¼
Perfume	1
	535

The method adopted for working up this formula is as follows: Commencing with cooling frame, the materials are framed, thus avoiding framing the soap. This necessitates the use of a good tight frame in which the cotton seed oil, palm oil, and tallow, carefully weighed or measured, according to the proportions given above, are placed, having first been warmed to a temperature of 115° Fah. The resin, previously warmed and cut with a small amount of weak lye to keep it fluid, is then added.

The frame is now rolled under the mixing machine, which has movable shafts and blades. These mixer shafts are lowered into the foregoing mixture and set in motion. The caustic lye and the sodium silicate are now added, and the mixture stirred for seven to ten minutes, when the starch and sal soda and silex are added, and the whole stirred for another four or five minutes. The mixture should then have a glossy and smooth appearance, indicating that the incorporation is complete. The perfume is added, the mixing blades removed, and the frame set aside to cool. The soap will be quite hard in a resonable length of time. It may be stripped on the second day, and cut upon the third. The difference in cost between tallow and cotton seed oil introduces the element of economy, while there is no loss save the moisture which evaporates during the three days' cooling, no spent lye and no nigres. Lastly the soap is found to do good work in actual use in the wash tub, containing less moisture than there usually is in boiled and settled soaps.

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The World's Columbian Exposition.

THE MOTIVE POWER AND ITS TRANSMISSION.

The industrial world will find an instructive lesson in regard to the generation and transmission of power at the World's Columbian Exposition at Chicago, for the latest improvements in these lines will be elaborately and completely shown. The contrast between this and the Centennial Exposition will be marked, not alone in the direction of radical changes, but in the refinement and improvement of methods then in vogue. The immense Corliss engine at the Centennial was an efficient type of the simple engine as then used in cases where large units of power were demanded. This one engine of 1,400 nominal horse power capacity furnished all the power required at that exposition. The power was transmitted from a fly wheel that was thirty feet in diameter and weighed fifty-six tons to lines of shafting underneath the floor, and was in turn transmitted from these shafts by means of belting to its several uses.

At the World's Columbian Exposition sixteen such immense Corliss engines would not be equal to the demands for power. Or to put it in other words, the industrial condition of the country as represented by the Centennial Exposition has doubled in volume each year since then, with the World's Columbian Exposition taken as the unit of the magnitude of the industries of this country to-day. At the Centennial electricity as a practical useful force was only a dream. At the World's Columbian Exposition it monopolizes things. The engines so far contracted for represent 23,000 nominal horse power. And of this vast amount of power, practically one-half will be utilized to generate electricity to supply the incandescent lighting installation. About 5,000 horse power will be required to operate the arc lighting plant, and the electric motors so far contracted for aggregate something over 4,000 horse power. This leaves only a nominal amount of power to be transmitted by means of shafting.

The Palace of Mechanic Arts will call for a much larger amount of power to operate machinery than any other building, and in cases where this power is transmitted by means of shafting it will be done, as was the case at the Centennial, from mains underneath the floor. The amount thus transmitted will, it is believed, not much exceed a thousand horse power. Electric power will also be used in this building for operating machinery, for running the three electric cranes and for other purposes.

But the great economy and advantage of electric transmission of power is found in supplying it to the other buildings needing it, and yet keep the one great power-generating plant intact. Thus it is about 1,400 feet from the power plant in the Palace of Mechanic Arts to the center of the Electricity Building. Several hundreds of horse power will be required in this building, and it will be supplied wholly by electric motors. The center of the Agricultural Building is a thousand feet from the power plant; the Mining Building is nearly 1,500 feet away, and the Transportation Building some 2,000 or more feet away. In all these cases the only feasible method of transmitting power is by the method adopted—that of electric motors.

A study of the engine plant that is now being installed in the Palace of Mechanic Arts is a lesson in the progress in engine building during the intervening years since the Centennial. As has been said, the immense Corliss engine was at that time a type of the simple engine when large units of power were required. A study of the present exposition plant shows the extent to which the further expansion of steam has been utilized. The largest engine to be installed will weigh only a part of the 700 tons that the big Corliss did, and will yet have greater horse power—2,000—and will be quadruple expansion. This will be the only engine in the plant probably that will utilize this degree of expansion of steam. But there will be four engines that will be triple expansion, three of them being of 1,000 horse power each.

Over fifty engines have already been contracted for; three-fifths of them are compound engines, either tandem compound, double tandem compound, cross compound, or vertical compound. And these engines are of large units compared to engines in general use in the industrial world. Several of them are of 1,000 horse power, and the average for all the compounds is nearly 450 horse power. A dozen simple engines will also be installed.

The generating of electricity has called for the development of the high speed engine. Whether this type of engine has reached the zenith of its popularity is not a question to be discussed, but it will be fully represented in the power plant, there having been perhaps fifteen contracted for. This type of engine is of recent development, and of much more recent perfecting, but nearly all the leading makes will be represented.

One of the latest phases in the use of engines as regards the generating of electricity, which is attracting the attention of builders of engines and electric generators—that of direct connecting instead of belting—will be more fully exploited than was at first understood it would be. Six of the ten-thousand-light incandescent dynamos are to be direct-connected. And in addition to these, there will be two or three other direct-connected sets of smaller capacity.

The greatly increased use of electricity, and its special adaptability for power purposes, especially for long transmissions, has materially changed the processes of generating power and of transmitting it since the Centennial Exposition. A well known engineer who was inspecting the power plant as planned for the Palace of Mechanic Arts, remarked to the writer a few days ago, "This may be Machinery Hall, but so far as the power plant is concerned, it is practically an electrical exhibit."

It will be seen that all the progress that has been made since the Centennial Exposition in the direction of the more economic generation and transmission of power will receive the fullest attention at the hands of the World's Columbian Exposition management. And the value of the Exposition, as an instructive factor in the commercial and industrial world, is thus enhanced. Economics have been well studied and recent tendencies in practice fully exemplified, particularly, as has been stated, in the concentration of the power plant into a unit, as it were; the fullest expansion of steam as now utilized, the most efficient transmission of power, particularly for long distances, and the method of direct connecting in electric generating plants.

MISCELLANEOUS NOTES.

The Awards.

After considerable disagreement and much discussion, it has finally been decided that the awards at the Exposition will be made under a straight jury system, the rules adopted providing for a large general jury, to be divided into thirteen departmental juries, which will do the work. Exhibitors entering into competition for prizes will receive a written report, telling why each has or has not been awarded a prize, and from this report an appeal may be taken to an executive committee, which may order a re-examination.

The Great Naval Parade.

The naval parade to take place in New York harbor next April, preliminary to the opening of the Exposition, is now being provided for. Rear-Admiral Gherardi has been appointed to the chief command, and the North and South Atlantic stations are to be temporarily discontinued, Admirals Benham and Walker then serving under Admiral Gherardi with the ships of their respective commands. Besides a full participation in the parade by the vessels of foreign nations, the representatives of our own navy will include the fine 8,150 ton armored cruiser New York, perhaps the best of her class in the world; the Miantonomoh, interesting as a harbor defender of the monitor type; the swift protected cruisers San Francisco, Philadelphia, Baltimore, Charleston, and Newark, of from 18 to 20 knots speed; the heavily armed Chicago and Atlanta; the gunboats Yorktown, Concord, and Bennington: the 2,000 tonners Detroit and Montgomery; the Bath-built gunboats Machias and Castine; the Dolphin and Bancroft, the novel Vesuvius, the torpedo boat Cushing, the Essex, and, finally, the renowed Kearsarge, which sank the Alabama in the closing days of our civil war.

Allotments of Space.

There has been a great deal of fault found with the allotments of space in the fair buildings.

The space in each of the great structures is now practically all assigned, and many have been excluded who counted to a certainty upon being exhibitors, and been to considerable expense to that end, while a far larger number have been allowed so small a space, in comparison with what was asked for, that their disappointment is keen. It is only just to the managers to assume that they have endeavored to do the best possible, and that they have intended to treat all with equal fairness, but it is evident that the vast buildings, great as they are, will be crowded to their utmost, and still be markedly inadequate to hold all the exhibits which should find a place in the fair.

The Receipts and Expenditures.

The receipts and expenditures for the fair, according to the last monthly report of the treasurer, have been as follows:

RECEIPTS.

Balance received from temporary organization.	$4,252 64
Received on current installments of stock subscriptions	5,402,184 40
Receipts from banks for interest on deposits	63,400 47
Received from city of Chicago on account of sale of bonds	5,003,726 06
Received for souvenir coins	734,546 00
Received from premiums on coins	10,022 28
From gate receipts at Jackson Park to Jan. 11	185,076 00
Received account 6 per cent debenture bonds	3,467,000 00
Received on account of interest on 6 per cent debenture bonds	14,824 37
Miscellaneous receipts from sundry sources	374,307 68
Received from various stock subscriptions not yet classified	108 40
Total	$15,259,488 30

DISBURSEMENTS.

Total disbursements on vouchers as per daily report to Auditor	$13,043,612 75
Total available cash on hand	1,315,838 55
Total	$15,259,448 30

The Tax Problem Solved in Sweden.

An interesting discussion has of late been going on among the officials in New York relative to the best way of collecting taxes. It is shown that an immense amount of personal property escapes taxation and consequently real estate pays the greater share. Some of the most experienced tax officials advocate the abolition of personal taxes, owing to the difficulty of collection, and the placing of all taxes, or nearly all, upon real estate, which is always in view, and can be readily grabbed from the owner in case of non-payment. In an article in the *Forum*, Mr. J. W. Brooks describes the Gothenburg plan, by which the profits on liquor are made to take the place of a large if not the principal part of the public taxes. The New York *Sun* says:

A company was established by the reformers in 1865 to take over the public house licenses as they fell in, reserving the right to decide how many should be made use of, and in which parts of the town. The surplus profits were to be devoted to public uses, but later a reasonable interest was guaranteed by the city on the capital invested, and the whole net proceeds were turned over to the community. The company began operations in 1865, and in its existence of twenty-seven years neither director nor share holder has received a cent of profit, all the gains going into the public treasury. The system has spread over Sweden and Norway, and in the latter country, where in 1875 there were but 15 societies in existence, in 1889 there were 51. Innumerable difficulties, of course, arose from time to time. The modifications and variations in the details of operation have been multitudinous. The chief principle, however, is to deprive individuals of the strongest motive for stimulating the sale of spirits—that of personal gain.

Of profits that have accrued to the communities through the disposition of the profits from the liquor business, Mr. Brooks tells much that is interesting. For example, Bergen, a town of fifty thousand inhabitants, has in thirteen years received nearly four million dollars, which, under the old system, would have gone to the distillers and private liquor dealers. But this fact of the community benefiting so largely from the liquor business constitutes one of the great dangers of the Gothenburg system. It is greatly to the interest of the taxpayers to have the liquor sales as large as possible, because this lightens other taxation. This difficulty has been dealt with in a variety of ways. In Norway the taxpayers' interest is made as slight and indirect as possible. The liquor profits are used as far as possible in public improvements. The establishment of parks, baths, reformatories, technical schools, even improved workmen's dwellings, are a few of the things on which the liquor revenue is spent.

At the same time Mr. Brooks admits the existence of serious objections to the Swedish plan. He does not think the best hope it offers to us lies in the actual lessening of sales. Rather the system as compared with private selling gives a basis for an aggressive and efficient education of public opinion upon the liquor question. He does not think the system could be introduced in any of our large cities. The "alliance of rum and politics" would stifle any effective agitation of the question.

Peculiar Effects of Electric Welding.

Some of the men employed at the Kolomna iron works, in Russia, have lately had some unpleasant experiences. Electric welding is practiced there according to the Bernados process. While engaged on the trying work the artificer's eyes were, of course, protected by tinted glasses, but the skin being exposed, the following symptoms were manifested: Burning sensation on the skin and in the eyes; in from three to four hours, discharges from the nose and the eyes; three to four hours later, a dry cough; four to five hours later, swelling of the skin and development of other symptoms; eight to ten hours from the commencement of the disorder, continuous irritation of the eyes, lasting from four to six hours; and finally, coloring of the skin. Then the various effects ceased, and the skin began to peel. On the third day the cuticle had completely decorticated, and by the sixth all the painful symptoms disappeared. But for weeks afterward the skin remained colored. These effects, it would seem, are exactly the same as those which are induced under scorching by the sun. The best protection which can be afforded the workmen against the evils mentioned, M. Maklahoff, the manager of the works, believes consists in a covering of yellow waxed cloth or red and green veils.

An Amidol Formula.

Mr. W. T. Wilkinson, in *Wilson's Photographic Magazine*, gives the following as a good formula for an amidol developer for ordinary work:

Amidol	120 grains.
Water	20 ounces.
Potassium bromide	10 grains.
Soda sulphite	1 ounce.

Such a mixture gives fine, strong negatives in the studio.

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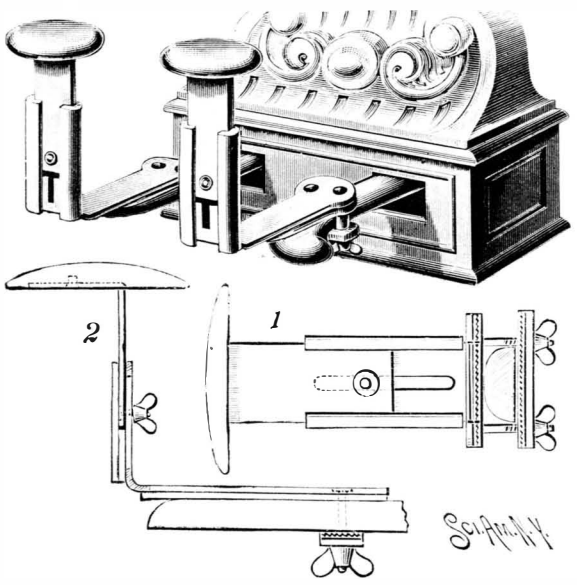
AN IMPROVED PEDAL ATTACHMENT.

An attachment readily applied to the ordinary pedals of a piano or organ, and which can be quickly adjusted to afford foot rests of such height as may be desired for children or very short persons, is shown in the illustration, and has been recently patented by William A. Hobday, M. D. Figs. 1 and 2 are front and side sectional views of the device, which has an angular body whose vertical member has slide-

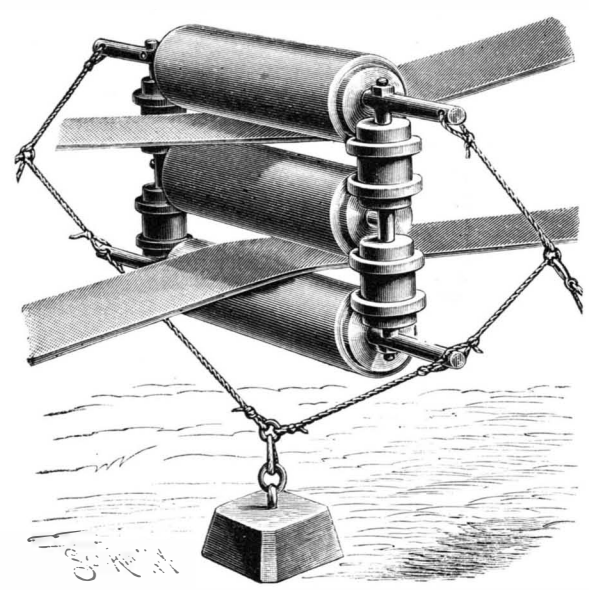


HOBDAY'S PEDAL ATTACHMENT FOR ORGANS OR PIANOS.

ways in its side edges in which slides an extension section, having a head adapted to serve as a foot rest, a bolt attached to the extension section extending through a slot in the vertical member, and the height of the foot rest being adjusted by means of a thumb nut. The under face of the horizontal member has an attached pad, and connected to its rear end by bolts and thumb nuts is a transverse plate, whose upper surface is padded. In applying the device, these thumb nuts are sufficiently unscrewed to permit the pedal to be passed between the upper padded surface of the transverse plate and the under padded surface of the horizontal member, when the nuts are screwed up to tighten the device upon the pedal, as shown in Fig. 2 and in the perspective view, the vertical extension being afterward adjusted as may be desired. Further particulars in reference to this improvement may be obtained by addressing the inventor, room No. 10, Pickering Building, Cincinnati, O.

A BELT GUIDE AND TIGHTENER.

The device shown in the picture is more especially designed for use on thrashing machines and in other places where driving belts are exposed to the wind. It has been patented by Mr. William F. Cleveland, of Rounthwaite, Manitoba, Canada. The shafts on which the horizontal and vertical rollers are journaled form a frame for the device, and one of the vertical shafts with its rollers may be removed by taking out bolts or



CLEVELAND'S BELT HOLDER.

pins at the ends, when the top and bottom horizontal shafts may be slightly sprung apart to facilitate attaching the device to a belt. To hold the frame and rollers in proper position a weight is suspended from the lower shaft, and the ends of both upper and lower shafts are connected by suitable ropes with stakes driven in the ground. As a portable guide and tightener the device can be readily applied on almost any long belt, sufficient tension being given the ropes to tighten the belt as desired. By its use, also, the labor of setting heavy engines exactly in line with the separators may sometimes be avoided.

The War Ship Chicago.

It appears from the recent annual report of George W. Melville, Chief of the Bureau of Steam Engineering, that some of the vessels of our new navy have already become antiquated and require to have new and better machinery put in. Here is what the chief says of her:

It is not likely that the boilers of the Chicago can be depended upon for more than three years (or one cruise) longer, and it is none too soon to consider the question of replacing them. The Chicago has been in constant and very active service since her completion, and the consequent wear and tear upon her boilers has been as great as that of two or three cruisers of the older type of ships, which performed their voyages mostly under sail. The hull of this vessel is of excellent design and in first-class condition, and she is, therefore, well worth fitting with modern machinery. The present boilers are externally fired with brick furnaces—a type that has some merits, but whose great weight for the power developed renders its use on a modern ship of war inadmissible. The engines are compound beam engines—a type that is also heavy, unsuitable, and out of date.

The machinery of this vessel weighs, in steaming condition, about 1,042 tons and occupies fore and aft in the ship a length of 142 feet. The greatest horse power ever developed by it was 5,248, and the speed of the vessel slightly over 15 knots.

The machinery in one of the newer vessels of the navy has developed 8,800 horse power on a weight of about 750 tons in steaming condition and a space fore and aft in the ship of 130 feet; in other words, nearly 70 per cent more power than the Chicago, on more than 25 per cent less weight, and a space occupied fore and aft less by 12 feet. Similar machinery to this can be fitted in the Chicago, and will give her an increase of speed of nearly three knots, as well as an increased carrying capacity of nearly 300 tons.

To decrease the weight of the machinery of a vessel to that necessary for the safe production of the power desired means more than merely additional weight or space available for something else; it means also that the needless expense of freighting unproductive dead weight around the world is avoided, and this expense in the case of a vessel like the Chicago will soon amount to a very considerable sum.

In view of the foregoing it will, in my opinion, be extremely unwise to furnish the vessel with new boilers and allow the present engines to remain in her. It is believed that machinery to develop 8,800 horse power can be built for between $500,000 and $600,000; probably for $500,000, if suitable old material on hand in some of the navy yards is utilized, as well as parts of the present machinery, such as pumps, blowers, line shafting, etc. I therefore recommend that an appropriation of $200,000 be asked for to begin the construction of new machinery for this vessel, either by contract or at the New York navy yard; work to be commenced as soon as the appropriation is available. When completed, probably about two years from commencement, the vessel can be laid up to have it erected on board, and her services thus lost for a comparatively short time only.

MONUMENTAL LUMINOUS FOUNTAINS.

Mr. Gustave Trouve's luminous drawing room fountains were described by us at the time of their presentation to the Academy of Sciences. The simplicity of the mechanism and the direct and powerful illumination of the liquid wheat sheaf jets permitted of reducing them to small dimensions that the inventor, in addition to the drawing room model, constructed luminous fountains of demonstration for cabinets of physics and even table fountains. These same advantages were likewise to facilitate the construction of monumental luminous fountains. As the jets of water are entirely united in the luminous pencil directed by a parabolic projector of a very sharp curvature, it will be conceived that with an adequate electric source the dimensions of the fountains may be as large as one desires; and, since such source may always be given the intensity desired, one will find himself practically arrested only by the rapidly increasing difficulty of submitting great masses of water to considerable pressure. Fig. 1 represents the new luminous fountain constructed by Mr. Trouve. It adorns the winter conservatory of the magnificent Craig-y-Nos Castle, in Wales, the royal home of Madam Adelina Patti Nicolini, the great cantatrice.

This fountain, which weighs ten thousand kilogrammes and is placed in a basin of water six meters in diameter, is automatic. The water that falls back into the basin is led by a discharge pipe to a small overshot wheel, which through the intermedium of an endless screw and a train of wheels actuates two circular screens with sectors of variously colored glasses. These two screens, one of them mounted centrally upon rollers and the other eccentrically, revolve in opposite directions, with equal or unequal velocities, as may be desired. To sixty revolutions of the bucket wheel corresponds about one revolution of the disks. The combination of the double rotation and of screens with multiple colors is a happy one, in that the effects of light obtained are very unexpected.

The aspect of the jets, in turn monochromatic and polychromatic, and incessantly varied, like the figures of a kaleidoscope, seems always new.

The automaticity of the great condensation of the light at the focus of the reflector accommodated itself better to incandescent than to arc lighting, but this required quite small although very powerful lamps. To this effect, Mr. Trouve has bent the carbon filament into a spring of five or six spirals. The luminous power, concentrated into a very small space, is thus quite sufficient and easy to place at the center of the reflector. In the present case, the electromotive force being 110 volts and 6 amperes, the consumption of one

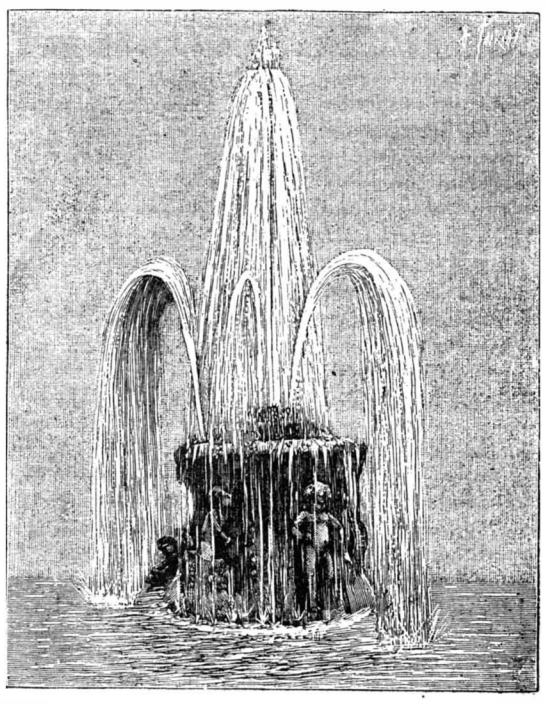


Fig. 1.—TROUVE'S LUMINOUS FOUNTAIN.

lamp is at the rate of one candle per 3 watts, and of 220 candles per lamp, say 880 for the four lamps.

Precautions have been taken to prevent ram strokes upon the glasses on the entrance of the water. A bell glass placed in the interior of the rock is branched upon the conduit, and the cushion of air obtained so deadens the blow that no break is to be feared. The thickness of the glasses is 25 millimeters and their diameter 300.

Fig. 2 shows the arrangement of the glasses, screens and reflectors. These new fountains require no maintenance; a cock is turned, the water enters and the circuit is closed simultaneously. The cost of installation likewise is reduced to a minimum. There is no subterranean foundation work, and any basin can be used just as it is. The whole of the expense is therefore reserved exclusively for the decoration.—*La Nature.*

A FRIGHTFUL accident occurred at the White River Iron and Steel Works, near Muncie, Ind., the week before Christmas. By the release of the rolls, at the end of the night shift, the belt was thrown off the governor, when the engine commenced running at a fearful

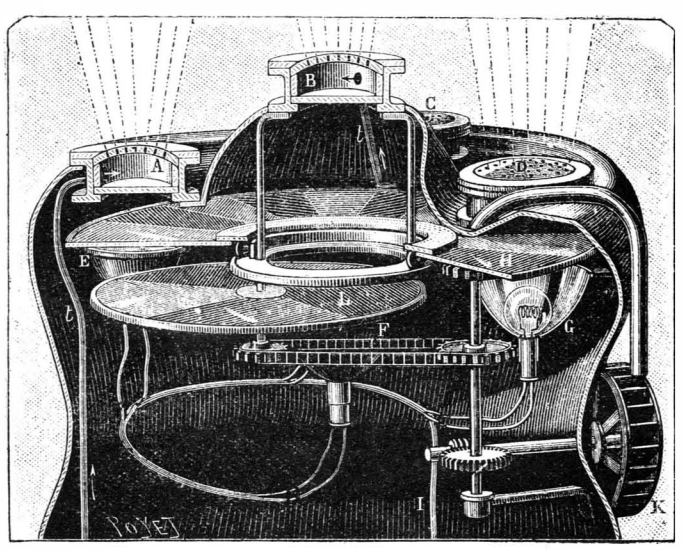


Fig. 2.—TROUVE'S LUMINOUS FOUNTAIN.

speed. The engineer and foreman jumped for the throttle valve, but too late. At that moment the great fly wheel burst in pieces, instantly killing the foreman and fatally injuring the engineer. The engine and part of the building became a total wreck.

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THE FIRST OVERHEAD-PROPELLED STREET RAILWAY.

This plan for street railway car did not work by electricity, but by cable, which was stretched on poles, and a grip device, that answered in place of the trolley, was used. We give illustrations. It is the patent of Foster & Brown, granted January 18, 1859. On the roof of the car was a bar, F, on which a sliding grip standard was arranged, with springs on each side of its base. The grip acted like a pair of nippers, and when the conductor of the car pulled a string the nippers opened, and were again closed upon the cable by the pull of another string, which worked a locking button, *f*, as shown in Fig. 3. The cable was intended to be kept in constant motion, and the car could thus be propelled and stopped at will.

This device carries a dim pictorial suggestion of the modern electric street railway, in that it takes power from a cable suspended above the car, but beyond this there is no analogy. It has the distinction, we believe, of being the first overhead-propelled street car. The Brown who here figures as a patentee was the Rev. Harvey Brown, formerly a well known citizen of Harlem, New York City, where he died, several years ago. He was a man of much ingenuity, the author of various useful inventions.

Fig. 3.

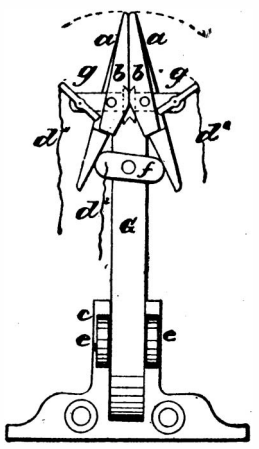


Fig 2.

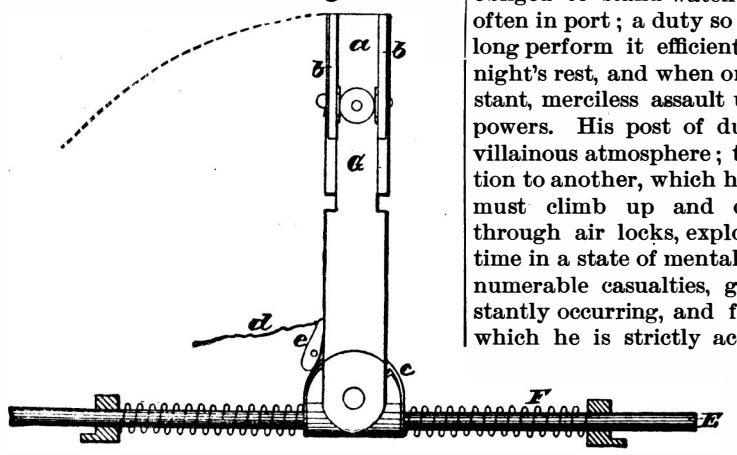
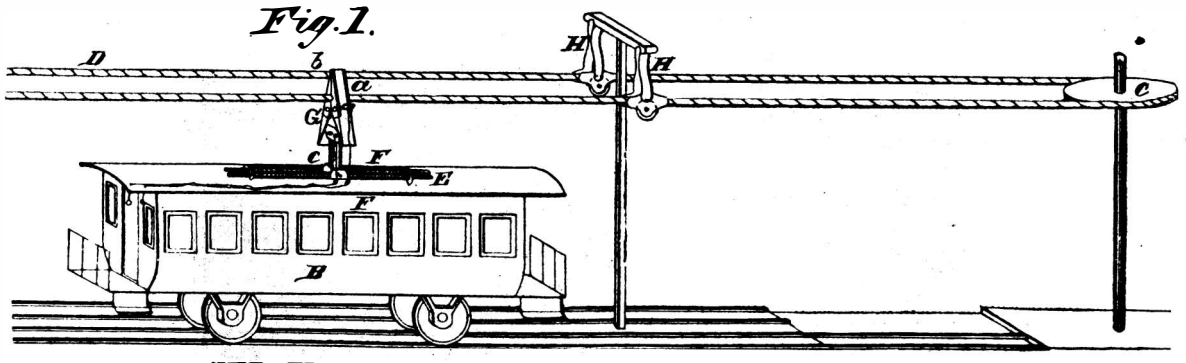


Fig. 1.



THE FIRST OVERHEAD-PROPELLED STREET RAILWAY.

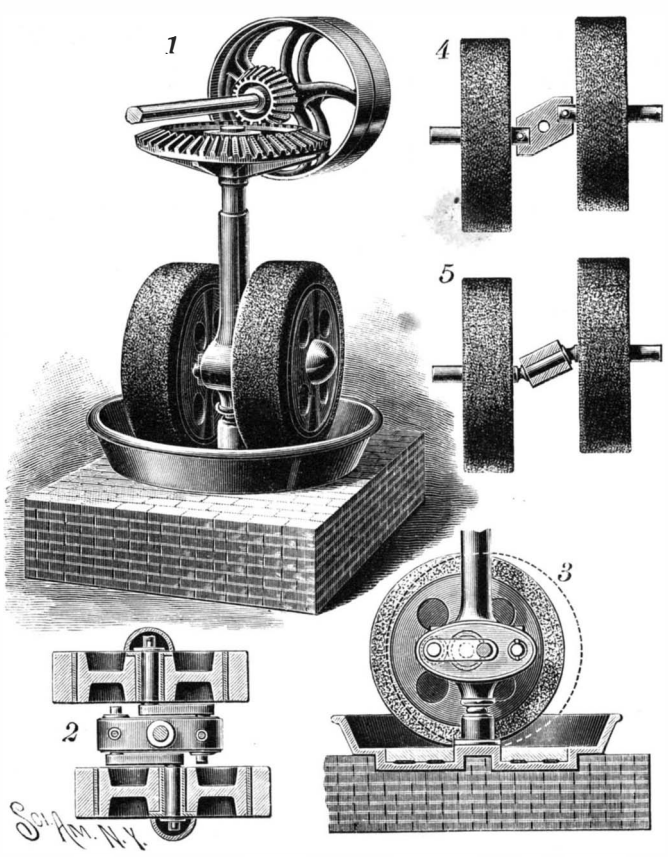
Cinnamon as an Antiseptic.

"No living germ of disease can resist the antiseptic power of essence of cinnamon for more than a few hours," is the conclusion announced by M. Chamberland as the result of prolonged research and experiment in M. Pasteur's laboratory. It is said to destroy microbes as effectively, if not as rapidly, as corrosive sublimate. Even the scent of it is fatal to microbes, and M. Chamberland says a decoction of cinnamon should be taken freely by persons living in places affected by typhoid or cholera.

IMPROVED MEANS OF RUNNING MILLSTONES.

Mr. Henry Mantey, Master Mechanic of the Ferrocarril Mexicano, residing at Orizava, Mexico, has recently patented some important improvements on Chilean or vertical mills, which counteract the tendency of the millstones to press outward upon their bearings under the influence of the centrifugal force, and thereby greatly decrease the wear of the axles and their bearings. The axles upon which the millstones are mounted are not arranged radially, as is customary, but are inclined forward with relation to the radius of revolution, so that the resistance of the working faces of the millstones (which is always in a direction at right angles to the radius of revolution) will give them an inward tendency on their axles and counteract their outward tendency from the centrifugal force. The improvements are represented in the accompanying cuts, Fig. 1 being a view in perspective, Fig. 2 showing a top section over the millstone axles, and Fig. 3 a vertical section. A cross beam is mounted at its center on the vertical operating shaft, and at opposite ends of the beam are journal boxes in which the inner ends of crank axles are journaled and held, the millstones being secured on the outer ends of the crank axles. The lower end of the shaft is journaled upon a central step of the foundation, in an annular depression of which, surrounded by the basin, is the bedstone on which the millstones travel as the shaft is revolved by a beveled cog gear keyed to the main power shaft. The millstones rise and fall automatically to suit the varying conditions of the ore, grain, or other substance being ground, but are not subjected to the usual centrifugal strain, because the axle ends are forwardly inclined with reference to the radius of revolution, as shown by the dotted lines in Fig. 3. In Figs. 4 and 5 are shown modifications of the improvement, the axles of the millstones being joined together in each case by a casting secured at its center to the operating shaft.

As the centrifugal force varies with the rate of speed at which the mill is run, the adjustment of the inclination of the axles to the tangent of the circle of revolution, to correspond with the rate of speed, becomes a matter of considerable importance, and the providing of means to accomplish this result affords the subject of another patent issued to the same inventor. Several different forms of adjustable crank axles and journal boxes are provided for, including means for applying the improvements to a mill employing four millstones, in all of which the position of the axles can be adjusted to such nicety that they will exactly counteract the centrifugal force, at whatever speed it is desired to run the mill.



MANTEY'S EDGE RUNNER OR VERTICAL MILLSTONE.

More Engineers Needed in the Navy.

To provide for the proper supervision and care of the immense amount of steam machinery we have now building or already afloat, provision must be made by Congress for a sufficient increase in the membership of the Engineer Corps to admit of the detailing of enough officers to all ships to stand proper watches in the engine department, and at the same time not neglect the very important shore duties. Objection has been made to the detailing of this sufficient number of engineers to cruising ships on the ground that there is not room for them on the ships. I hold that quarters should be provided for the people who are indispensable in the maintenance of the ship, and that it would be better to make reductions elsewhere than to allow a million dollars' worth of machinery and the work of 100 to 150 men go uncared for, even though the cry be raised that the ship has too many engineers when a sufficient number is detailed for necessary duty.

For any cruising vessel of 5,000 horse power and upward there should not be less than one chief engineer and four assistants, while in some of the new vessels of great power there should be a sufficient number of assistants to have two officers on duty at a time.

On our most powerful ships—those of from 5,000 to 10,000 horse power—the usual complement now is one chief engineer and three assistants, the latter being obliged to stand watch in three watches at sea, and often in port; a duty so exhausting that no officer can long perform it efficiently, for he never has a whole night's rest, and when on duty has to withstand a constant, merciless assault upon his physical and mental powers. His post of duty is one of intense heat and villainous atmosphere; to get from one part of his station to another, which he must do very frequently, he must climb up and down narrow ladders, crawl through air locks, explore coal bunkers, etc., all the time in a state of mental anxiety on account of the innumerable casualties, great and small, that are constantly occurring, and for the prompt remedying of which he is strictly accountable; in one watertight compartment some boiler tubes are leaking and the men are in a panic; in another, a hundred feet or more away, a feed pump is refusing to work or a thrust bearing is hot, and while hurrying from one scene of danger to another the engineer is liable to receive tidings of trouble in some remote coal pocket, or even be summoned to appear on deck, where he must calmly answer questions regarding the amount of smoke escaping from the smoke pipes or the necessity for hoisting ashes, wholly unmindful of the disasters which he knows are impending below. So it goes, watch after watch and day after day, until in the course of a week or two the engineer is a nervous wreck, fit for nothing but the hospital; and all because the lack of numbers imposes upon him the work of at least two men.

In ships of 3,000 or 4,000 horse power, like the Bennington or Boston, for example, the chief engineer has but two assistants, who are assigned to what is termed "supervisory watch" at sea; in theory the officer on duty need not remain constantly at his post, but in practice he cannot sit complacently in his quarters and allow his responsibilities to take care of themselves; so that really the duty imposed upon the two officers amounts to standing watch and watch, six hours on duty and six hours off, or twelve hours daily, day and night for days and even weeks at a time. Such a condition reduces those who have to bear it to the mere animal existence of a beast of burden, and I wonder at the constancy of intelligent men enduring it with nothing to sustain them beyond the hope that a change for the better cannot be far off.—*1892 Report of Chief of Bureau of Steam Engineering.*

Warm Feeling Produced by Carbonic Acid.

It has often been observed that the natural man does not like a number of things which are demonstrably good for him, while exhibiting a deplorable fondness for even more things which are notoriously bad for him in many respects. Among these may be named ventilation, the desirability of which was discovered by sanitarians, but which uninstructed mankind persists in neglecting for the greater attraction of coziness. Whether this positive liking of unscientific man for a stuffy atmosphere has any justification, is a question which sanitarians would probably decline to discuss, but it suggests itself in connection with certain experiments of Dr. Rene du Bois Reymond, recently described to the members of the Berlin Physiological Society. This communication went to show that a sensation of warmth ensues on immersing the skin, say of the hand, in a vessel containing carbonic acid gas. Some other gases produce the same effect, but they are gases not usually found in air. The warming sensation produced by carbonic acid gas is compared with that of air at a temperature of 68° Fah. This phenomenon does not yet admit of a physical explanation, but is regarded rather as resulting from a chemical stimulation of the sensory nerves for heat perception. There may not be any real connection between the experimental truth determined by Dr. du Bois Reymond and the dislike of fresh air in their dwellings shown by people of low culture, but the coincidence is at least an odd and a striking one.—*Jour. of Gas Lighting.*

A STEEL-LIKE grass from the volcanic slopes of Oran, Algeria, is said to be so elastic that it can be used instead of springs in the manufacture of furniture.

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CHARLES T. YERKES.

To say that the name of Charles Tyson Yerkes is the most widely known in Chicago would not be far from the truth. To be the mainspring of the concern that controls two of the largest cable railway systems in the United States means more than the uninitiated readily imagine. A man in such a position, with 7,000 men employed, and 290 miles of the arteries of city travel under his supervision, means that he must be the subject of baseless criticisms, and possess unbounded resources, an utmost *finesse*, and combine the successful elements of a general, a financier, a politician, and the far reaching experience of street railway practice which goes to make the thorough street railway man. In short, few positions in business life demand so many highly educated and varied abilities—abilities which in most other avenues of trade would suffice for four men.

Mr. Yerkes was born at Philadelphia, June 25, 1837, of a Welsh ancestry and Quaker parentage. The Yerkes family came from the mother country in 1682 and became Quakers by adoption on reaching the demesne of William Penn.

According to the custom, young Charles became a student at a Quaker school, to learn the rudiments, and finished his education at the Central High School of Philadelphia. After his school days he became a clerk in the flour and commission business, and so well were his employers pleased that they presented young Yerkes with $50 at the end of his first year, although the custom was to give no salary to apprentices.

In 1859, when he had arrived at the age of 22, he started in the broker's business for himself, and in three years bought out a banking house at 20 South Third Street. Everything that he touched turned to gold, and he soon was counted among the solid men of the City of Brotherly Love.

The course of business, like that of true love, does not always run smooth, and at the time of the Chicago fire several heavy and unavoidable reverses overtook Mr. Yerkes. It was at this time that he began dealing in street railway stocks and bonds, and at the time of his reverses he was a large holder in the Seventeenth and Nineteenth Street Railway Company. All this went to pay his debts.

In 1873 Mr. Yerkes set resolutely at work to recoup his shattered fortune, and as early as 1875 became interested in the Continental Passenger Railway Company and saw the stock rise from $15 to $100 a share.

In the year 1880 Mr. Yerkes paid his first visit to Chicago, and while there became interested in the Northwest Land Company, with headquarters in Fargo, Dakota.

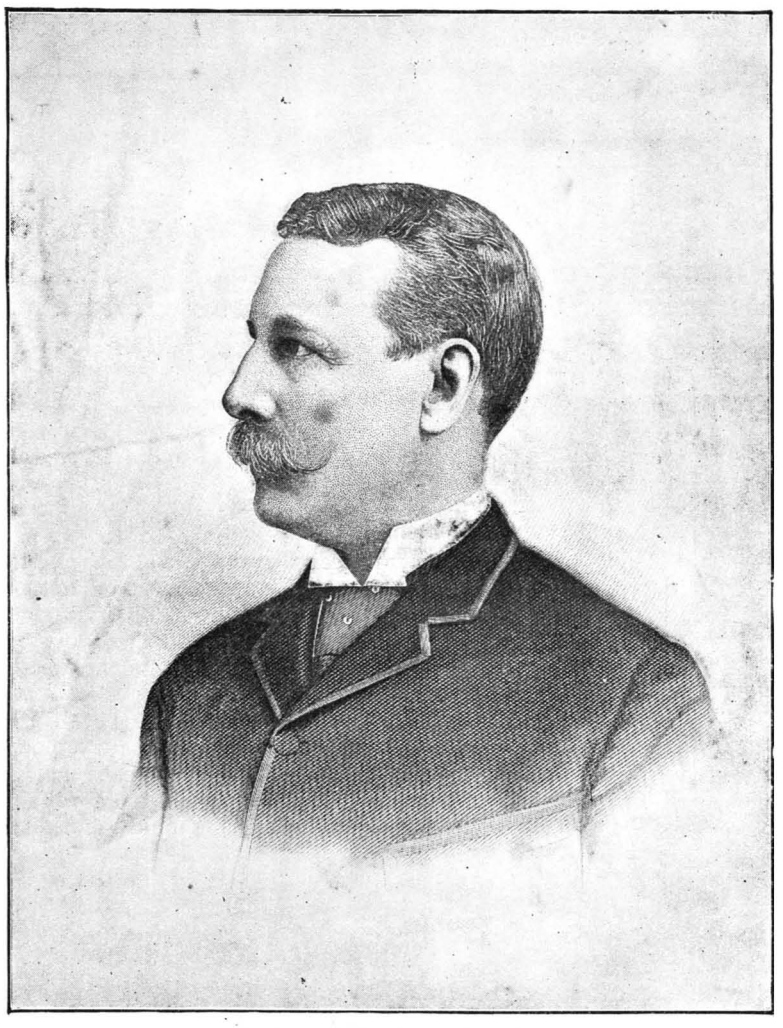
A year later he sold out his land interests and came to Chicago to enter the banking business, in which he remained five years.

In 1886 Mr. Yerkes began the work for which he is best known and to which he has so ably applied his great resources, that of the negotiations for the North Chicago Railway, which culminated in the installing of the cable system. The LaSalle street tunnel, which had been practically abandoned, was cabled with the first car track to cross under the Chicago River. In 1888 the West Chicago deal was consummated and mechanical traction by cable substituted for horses.

To the energy of Mr. Yerkes, his knowledge of men, and his unremitting application, the great divisions of North and West Chicago owe their present transportation facilities. One feature alone will illustrate the extent of his plans, namely, the construction by the West Chicago cable road of a tunnel under the Chicago River, at a cost of $1,500,000, for the exclusive use of the new Blue Island cable line.

Mr. Yerkes now resides in Chicago, in the full enjoyment of his vast wealth and a sound mind and body, with a constantly increasing circle of business connections upon which to exercise his tremendous ability.

Mr. Yerkes' wide generosity toward the great ends of science is well shown by his recent munificent gift to Chicago University of a $500,000 telescope, to be the "best in the world," the principle upon which Mr. Yerkes does everything. He also donated an electric fountain to Lincoln Park, at a cost of $100,000.—*Street Railway Review.*



CHARLES T. YERKES,
Donor of the $500,000 telescope to the University of Chicago.

The Wheat Crop.

If reliance may be placed upon the representations of the United States Department of Agriculture, our wheat crop for last year amounted to 495,181,000 bushels. This is less by 116,780,000 bushels than that of 1891, but is greater than that of 1890 by 95,918,000 bushels, than that of 1888 by 69,235,000 bushels. The crop of 1892 may, therefore, be regarded as an exceptionally good one, in quantity. In value? That's to be seen. To produce this 495,181,000 bushels of wheat, 39,933,100 acres of land were cultivated, the average yield being about 12·4 bushels per acre. Winter wheat averaged nearly 12·74 bushels per acre, while spring wheat averaged a little in excess of 11·71 bushels. Kansas is the banner winter wheat State, her crop being 58,071,000 bushels, produced upon 3,469,000 acres, an average of 16·74 bushels per acre. Kansas, this year, has produced nearly one-tenth of the entire wheat crop. Minnesota leads the spring wheat States, with a yield of 35,467,000 bushels from 3,206,800 acres, an average of nearly 11·06 bushels. In yield per acre Colorado leads all with an average of 20·7 bushels.—*Milling.*

Proposed Canal Between Lake of the Woods and Red Lake.

Prof. Nelson Daughters, a scientist, has devoted a year's time to the exploration of the Red Lake and Lake of the Woods regions in Northern Minnesota. As a result, he has evolved a scheme that, if carried into effect, will, he thinks, result in great benefit to the lumber, ore, and coal interests of the district of country indicated. He will outline this scheme in a lecture before the Chamber of Commerce at Grand Forks. He will therein demonstrate that a canal 10 miles in length can be cut that will connect by waterway the Lake of the Woods with Red Lake. Thus the Red Lake River and the Red River of the North will be supplied with five times the amount of water that now flows in those streams, and navigation will be thus secured from the Lake of the Woods to all points on the Red River of the North.

The scheme includes the use of Red Lake as an immense reservoir for logs cut on the Vermilion, the Little Fork and Big Fork Rivers, and other streams emptying into Rainy River, which can be floated through the Lake of the Woods and thence through the connecting waters and canal into Red Lake. The logs can be sawed at mills to be built at the outlet of Red Lake, or at Grand Forks, or any point along the route that operators may choose. The amount of pine immediately tributary to Red Lake, which will be soon placed on the market by the United States government, is estimated at 8,000,000,000 feet. If the canal shall be constructed as Prof. Daughters recommends, it will add 20,000,000,000 feet of pine to the amount that will be tributary to the water route as planned, and make of the Red River Valley another great manufacturing and distributing center like the Saginaw Valley. It will also furnish a water route for the conveyance of wheat and other farm products from the valley to the head of Lake Superior.

It is a great scheme, and if the professor can prove what he claims, there should be no difficulty in securing the requisite legislation and capital to dig a canal 10 miles long, especially since it will be an easy cut through a tamarack swamp. Professor Daughters made the passage by boat from Red Lake to within 10 miles of the Lake of the Woods, so says the *Northwestern Lumberman.*

The Compressed Feet of the Chinese Women.

A writer in the *Japan Mail*, who appears to have special knowledge of the subject, refers to the well-known Chinese custom of compressing the feet of female children of the better classes in China. He hopes that few of his readers have been so unfortunate as to see the naked foot of an orthodox Chinese lady. But many have looked at photographs of this terribly twisted and distorted member, and the sight must have suggested thoughts of barbarous suffering inflicted on a particularly sensitive part of the human body. Year by year hundreds of thousands of little girls, throughout the wide empire of China, are subjected to a ruthless process which crushes the bones and wrenches the sinews of their tender feet, until at last a revolting deformity is produced, and the foot, crumpled into a shocking monstrosity, becomes almost valueless as a means of locomotion. The wretched girl emerges from her period of feverish torture a mutilated cripple, condemned to hobble through life on feet which preserve no semblance of nature's beautiful mechanism, having become as hideous as they are useless. At intervals the missionary cries out, the traveler writes, and the charitable agitate; but the poor little children never benefit. For them there remains always the same ruthless bending of bones, the same agonizing application of tight ligatures, the same long months of bitter pain and unavailing tears. Perhaps, he suggests, it is to this singular contrast between general refinement and cultivation of the Chinese on the one hand, and this callous cruelty on the other, that we must attribute the periodical appearance of apologists for the appalling custom. Some people say that, though the foot is ultimately deformed, though the woman is indeed condemned to be little better than a cripple, yet the process is not so very painful after all. The bones are soft, they say, in early youth; the sinews supple. Twisting, crushing, and wrenching are operations that may be performed without much suffering on baby feet, whereas adults would be maddened by the torture. To this the writer replies: "Let no one talk of the yielding character of young bones or the pliability of baby sinews. We have listened with our own ears to the cries of a little girl undergoing the torturing process. Such agonizing wails never before fell on our ears. They were the shrieks of a child absolutely wild with suffering. When the ligatures were loosened and the shocking succession of breathless screams ended in long-drawn wails of exhaustion and misery, the listener turned almost sick with horror and sympathy. Yet a mother was the deliberate torturer of the poor baby, and a father callously listened to its heart-broken cries. Think that this fiendish barbarity is being practiced daily and hourly throughout the length and breadth of a land containing 300,000,000 inhabitants! Not alone are the tender bodies of the poor little girls ruthlessly racked and tortured, but the purest sentiment of humanity, the love of parents for their children, is perpetually outraged. Such unnatural cruelty could be tolerated only in the presence of the worst kind of demoralization. How much can survive of the moral beauty of the paternal relation when fathers and mothers, in deference to a mere freak of fashion, consent to inflict on their daughters, day by day, torture that well nigh maddens the baby brain and wrings shrieks of excruciating agony from the little lips? This is one of those facts that make us marvel when we hear a great destiny predicted for the Chinese nation."

Military Cycling.

Recently a few soldiers from Fort Sheridan, in command of Lieutenant Hunt, the detachment having had very little experience in riding, went to Pullman, just for curiosity to see how soon they could make the march from Pullman to Chicago, a distance of fifteen miles. They started in the morning with their full equipment, the same as men fitted for a campaign, in regular marching order. They made the distance, as I am informed by the officer, in one hour and twenty-five minutes' marching time. They were instructed to start early in the morning and arrive between nine and ten. In order not to be delayed they were directed to start early, and I instructed the officer that if he found that he was coming in ahead of time he could stop and rest at any place he wished. He rested quite a long time, and covered the distance, as I say, in the marching time of one hour and twenty-five minutes. The ordinary time of marching over the same distance, equipped as they were with their rifles and full equipment, would have been at least five hours. I asked the officer how the detachment stood the march, and he said they were very little fatigued, and would have turned around and gone back over the ground again with pleasure.—*Gen. Miles.*

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Correspondence.

The Chestnut Worm.

To the Editor of the Scientific American:

Under the caption of "How the worm gets into the chestnut," published in the Chattanooga (Tenn.) *Evening News* of Dec. 22, by a Pittsburg physician, it is said that the eggs are deposited by an insect, etc. Having been reared among the extensive chestnut forests of the foothills of the famous Walden Ridge, have closely observed, for the past six years, the brown chestnut and its only enemy. There appears, from the middle of August to the first of September, a bug, very like the common lady bug, possibly a little longer, whose head terminates in a downward curved mosquito-like bill, with which it bores into the soft green chestnut, from the bud end, there deposits its eggs, which subsequently hatch into the well known "chestnut worm." When the chestnut matures and falls out, this same bug is to be found, and remains until killed by the frost.

To keep a chestnut in a damp place you will observe, about the middle of August, the shell will begin to show signs of decay, after which the bud end will open and the bug make his appearance, covered with bright brown specks; and, armed with his wiry bill, go in quest of a place to propagate his race.

I have searched in all the natural histories available, but cannot find any trace of such an insect described above. The blight of the chestnut is growing more each year from this cause. I would be pleased for you to give me, if possible, some insight as to the first appearance of the insect through the SCIENTIFIC AMERICAN.

ROBERT L. BOLTON.

Sale Creek, Tenn., January, 10, 1893.

Prof. L. O. Howard, of the Department of Agriculture, to whom we submitted the above, says: Mr. Bolton's observations are in the main correct. The common chestnut worm is the larva of a weevil known scientifically as *Balaninus caryatripes*. A full account of it will be found in the fifth report of the U. S. Entomological Commission, pages 350–53. He thinks Mr. Bolton is mistaken in respect to the killing of the insect by the frost. This chestnut weevil is indigenous to this country. No remedies are known.

Safety Suggestions for Ocean Steamers.

To the Editor of the Scientific American:

I have read your "Safety Suggestions for Ocean Steamers" with great interest, and although not an expert, they appear to me of great importance.

I submit for your consideration the following suggestions, which you are at liberty to publish in the interest of the public or consign to your waste basket, as you may think proper.

First.—By providing air tight hatches and coverings, *to be used when necessary*, over engine rooms and such other openings in the deck of a ship as are usually left for ventilation, so secured as to safely withstand outward pressure equal to about two atmospheres, together with air pumps (to be worked by steam power or by hand), so placed as to be always accessible for compressing air in either of its compartments, and air locks through which men may pass when air is compressed therein. It is suggested that in case of an accident of any kind which causes one or more openings in the bottom of a ship, through which more water passes than can be pumped out, either of the several compartments, or all of them, may in a few moments be substantially converted into pneumatic caissons, and in a very short time all water therein which is above the level of the opening through which it has entered can be forced out through such opening or openings and kept out by compressed air. When this is done, the fractures in the hull of the ship would probably, in most cases, be easily accessible for repairs; and if for any reason repairs cannot be made at sea it would only be necessary to maintain the requisite air pressure in the leaky compartments, by pumping in as much air as might escape through the decks or otherwise, to secure the continued buoyancy of the ship for such length of time as might be required for it to reach its port of destination.

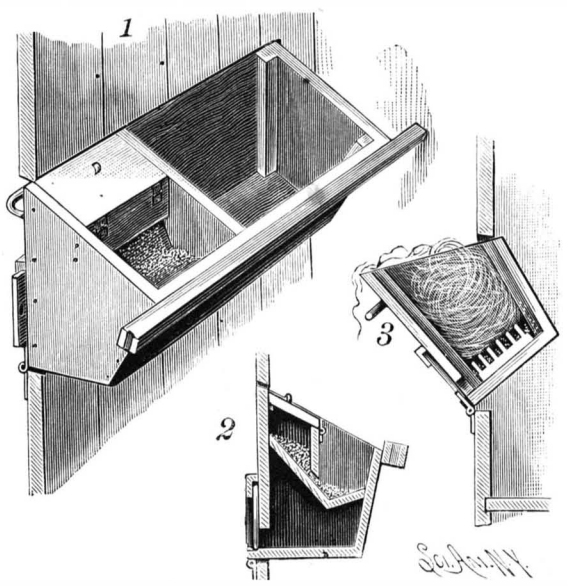
Second.—To provide an automatic device for giving instant notice to the officers of a ship when it enters waters of a temperature so low as to indicate the proximity of an iceberg, it is suggested that the poles of a galvanic battery be connected by wires forming two circuits, one much longer than the other. That a properly constructed thermometer be so placed as to be substantially submerged by the water which (when the engines of the ship are in motion) is continually passing from the sea into the ship for the purpose of condensing steam. That the wire forming the shorter electric circuit above referred to shall be cut and the ends thereof introduced into the tube of the thermometer, so that when the temperature of the sea water passing in contact with it is at or above such as may be assumed as the "danger line," the mercury therein will be in contact with the ends of the wire and complete the circuit. When the temperature of the sea water causes the mercury in the tube to fall below the assumed "danger line," or, in other words, so low as not to be in contact with the ends of the wire, the shorter electric circuit will be thereby broken, and, in accordance with a well known law, the electric current will then, and not until then, pass over the longer circuits, and in so doing may be made to ring an alarm bell on the bridge, or any other part of the ship, as may be desired, and unless the current is "switched off" by the officer of the ship, the bell will continue to ring until the ship passes into water of a temperature high enough to cause the mercury in the thermometer to rise and restore the continuity of the shorter circuit, when the bell will cease to ring.

T. B. BLACKSTONE.

Chicago, January 12, 1893.

AN IMPROVED MANGER.

The illustration represents a manger by the use of which the hay may be readily fed separately from the oats, and the compartments of which may be conveniently filled without stepping into or entering the stall. The improvement has been patented by Mr. Wm. Vender, of Kinde, Mich. It is hinged at its front lower edge to the front of the stall, through an opening in which it may be swung outward for filling, as shown in Fig. 3, while in its innermost position it is supported by a cross bar attached to the sides of the stall, as shown in Figs. 1 and 2, and to this crossbar the animal may be tethered. A partition divides it into two compartments, one for hay or cut feed and the other for oats or other grain. In the bottom of the hay compartment, Fig. 3, is a grate, through which seed or other particles may fall to the bottom, to be thence removed through a slot in the front, the impurities falling out through the slot when the manger is swung into an outermost position. While feeding cut feed the grate is removed and the opening is closed by a slide. The



VENDER'S MANGER.

grain compartment, Fig. 2, has an interior bottom, portions of which are differently inclined, and a transverse partition with a hinged lid forms a rear storage receptacle, through an opening at the bottom of which the grain is fed forward to the feeding compartment. With this construction the animal receives only a small quantity of grain at a time, additional amounts being fed from the storage compartment as the supply is consumed. A suitable handle at the front facilitates swinging the manger outwardly for placing the food in the different compartments.

An Ice Crusher and War Steamer.

There has just been launched from the yards of the Craig Ship Building Company, of Toledo, Ohio, a vessel which in two hours' time can be converted in all respects into a harbor defense ram, and with a rapid-fire battery well protected by steel shields can justly be expected to silence any craft the British are able to send through the Welland or St. Lawrence River canals. The new vessel is the Ann Arbor, built for the Toledo, Ann Arbor, and North Michigan Railroad, and designed expressly for immediate conversion into a war ship on the breaking out of hostilities.

The new vessel has been duly inspected by a representative of the Navy Department, and those in naval circles in a position to know declare that, had the new vessel been intended exclusively for war purposes, she could not have been better designed. The Ann Arbor will soon be followed by a second vessel, a duplicate throughout, and later by four more vessels of still greater efficiency.

The new vessel measures 267 feet in length and has a beam of 52 feet. Her draught is 12 feet and displacement 2,550 tons. This displacement is slightly in excess of that accorded to the new Ammen harbor defense ram now building for the United States. The Ann Arbor is provided with three screws, placed one on each quarter, well forward of the stern, and the third in the bow. The bow screw sets well aft of the stem, and occupies a position clear of the keel. The lower edge of the propeller blades are flush with the keel, making it impossible for the blades to touch bottom before the keel. The three screws are operated by three distinct sets of engines.

These engines are of the horizontal compound type, and are placed entirely below the water line. Each engine is distinct and separate from the others. The cylinders of each engine measure 20 inches and 40 inches respectively for the high and low pressure cylinders. The stroke is 36 inches. Steam is furnished by three connected steel Scotch boilers, 10 feet long by 14 feet in diameter. The boilers are intended for an ordinary working pressure of 125 pounds to the square inch. It is calculated that the new vessel will develop a speed of 14 knots per hour when tried. It is now recognized that had the triple expansion engines been used instead of compound engines, their speed might have been made to approach close to 16 knots per hour.

The adaptability of the new vessel for ramming purposes will be best understood when it is known that the hull construction is of oak up to two feet above the water line. At the water line there has been provided a belt of iron, extending all around the vessel and having a uniform width of six feet throughout.

In the bow and extending aft for a distance of 15 feet is a solid and massive backing of oak. Extra oak backing has been placed under all the beams along the water line, and there is a further longitudinal strengthening furnished by means of a steel cord running the entire round of the vessel and nipping together the oak backing. At a distance of every four feet this steel cord is connected with steel ties running to the keel. The keelson is strengthened with a steel plate two feet wide and three-fourths of an inch thick.

Ordinarily the Ann Arbor will be used to carry cars across Lake Michigan from Frankfort to Kewaunee, and this she will do throughout the entire winter months. Her hull has been so shaped that it will rise above and crush down the ice.

Alongside her longitudinal backing is an open and spacious run fore and aft, affording sufficient berthing room for 500 hammocks. The coal bunkers are placed on a longitudinal line amidship. The open fore and aft space along the sides has its decks some four feet above the water line, and gun ports marked off can be cut through if desired in a day's time for the mounting of broadside rifles. It is hardly deemed likely among those well posted that there will ever be any necessity for opening ports from the main deck space, as there can be placed on the upper deck a battery too powerful to be opposed by any vessel the British are now able to crowd through to the lakes. The battery of the Ann Arbor can be made up of as heavy ordnance rifles as the Navy Department may desire.—*N. Y. Times.*

The Advance in Armed Cruisers.

As Captain Noble remarked at the luncheon which followed the launch of the Yoshino, the powerful protected cruiser, 360 feet in length, built by Messrs. Armstrong, Mitchell & Co., at Elswick, for the Japanese government, and described in a recent issue, marks progress in the construction of ships of the class, the wonderful development being due, he said, in a considerable degree, to Lord Armstrong. First there was the Esmeralda, designed by Mr. George Rendell, a vessel 270 feet long, with a displacement of 2,950 tons, its speed being 18·3 knots, and its armament very powerful in those days. Then there were the Niniwa and the Takachiho Kan, designed for the Japanese government by Mr. White, the present chief constructor to the British Navy. They were a great improvement on the Esmeralda, being 300 feet long, and their displacement 3,700 tons; while their speed was 18·8 or nearly 19 knots. And now there is the Yoshino, whose displacement is 4,150 tons, whose indicated horse power is 15,000, whose speed is expected to be not less than 22½ if not 23 knots, and whose armament will comprise every refinement that modern artillery science can produce. These four vessels show an important advance in the building of armed cruisers; but the resources of the Elswick firm are not exhausted, for Captain Noble declared that if the Japanese government intrust them with another order, they hope to surpass even what they have done in the case of the Yoshino, which, it is thought, will prove the fastest cruiser afloat.

Economy of Tramp Steamers.

An illustration of the remarkable efficiency of some of the steam tramp vessels is seen in the Tekoa. This ship, belonging to the New Zealand Shipping Co., is built of steel, 4,050 tons gross measurement, with a dead weight capacity of 6,250 tons. She was built in 1890, to carry cargo between England and Australasia, and, in her speed trial, showed 11½ knots. Recently she ran from Teneriffe to Auckland, 12,059 nautical miles, without a stop and without slacking speed at an average rate of 10 knots, with a daily coal consumption of 21¼ tons for all purposes. Thus she transported a ton a mile by burning one-half an ounce of coal."

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HOW THE BROKEN SHAFT OF THE CUNARD STEAMSHIP UMBRIA WAS REPAIRED.

The unusual accident to the shaft of the Umbria in her recent westward trip while off the coast of Newfoundland on the 23d of December last has aroused the liveliest curiosity among engineers and others as to how a break or crack in the shaft within the inclosure of the thrust block and between the thrust collars could be so far repaired and the shaft strengthened as to allow of the vessel steaming several hundred miles to New York, her port of destination.

The Umbria is one of the largest and swiftest of the British mail steamers, being 520 feet in length, 57 feet 3 inches beam, 41 feet in depth, and of 8,000 tons, with triple compound engines of 14,500 I. H. P., giving her a trial speed of 19 knots, nearly 22 miles per hour; her regular average speed being over 18 knots or nearly 21 miles per hour.

While the Umbria was running at nearly full speed in one of the heaviest of our winter storms to the south of Cape Race, Newfoundland, Chief Engineer Tomlinson heard a rattling and saw something wrong in the motion of the engines, and he immediately stopped them. He then uncovered, by sections, the thrust bearings, when it was found there was a crack in the shaft between the 3d and 4th thrust collars on the end next the engine. See Figs. 6 and 14.

The plan for arresting the progress of the crack, which was nearly half across the shaft, was quickly made by Chief Tomlinson and approved by Captain McKay. The work of repair was commenced at once by tricing up the shaft at the recess between the 5th and 6th collars with a chain and turnbuckle such as are used on shipboard for lifting.

Some spare bolts were found, duplicates of those used in the regular end flanges of the shaft. These bolts were 5½ inches diameter by 12 inches long between head and nut, being 1½ inch short of reaching to the opposite sides of the adjacent collars, but the screw ends were long enough to hold the bolts in place.

A beam was rigged over and lengthwise of the shaft at a height to work two ratchet drills, one on each collar, and with which four holes, each 1½ inch diameter, were bored in each collar, down 5 inches or within 1 inch of the depth of the thrust collars. Thus relieved of the bulk of metal, slot openings were chipped out into the drilled holes to receive the bolts, which were also flattened on the sides by chipping four flat places to give them fair bearings in the mortises in the collars as shown in Figs. 7, 14, 15. The shaft was then turned one third over by the regular turn-over engine and its worm gear, and the operation of fitting in the 2d and 3d bolts was successfully completed.

In the meantime the ship's portable forge was at work in making two broad straps, one covering the crack which had run down the angle of the recess, and then across in a diagonal line, to bind the shaft in line, in case of an extension of the crack, the other strap on the outside of the bolts to keep them from slipping out of the slots. See Fig. 15. A strap was also placed in the next available groove in place of the chain trice and held in place by the large turnbuckles fastened from a beam overhead, taking the place of the chain to keep the shaft from sagging. The work was now ready for trial. By this arrangement 5 of the 13 thrust yokes were displaced, leaving but 8 in place to bear the thrust of the propeller screw.

Thus weakened in the torsional strength of the shaft as well as in its thrust resistance, a slow speed became necessary. Upon trial, one of the bolt nuts gave out after a two hours' run, another bolt being prepared and put in. No further mishap occurred, and, as it proved, the work of repair was equal to the duty placed upon it, the ship making about 9 miles per hour, reaching this port on the night of December 30, 7 days from the time of the break—the repairs occupying 4 days of this time.

Immediately upon the arrival of the vessel, Chief Engineer Tomlinson, with Messrs. Reid & Duff, of the Dumbarton Iron Works, this city, devised a method of repair to the shaft, such as would enable the ship to return to England, where a new shaft had been ordered by cable by the owners.

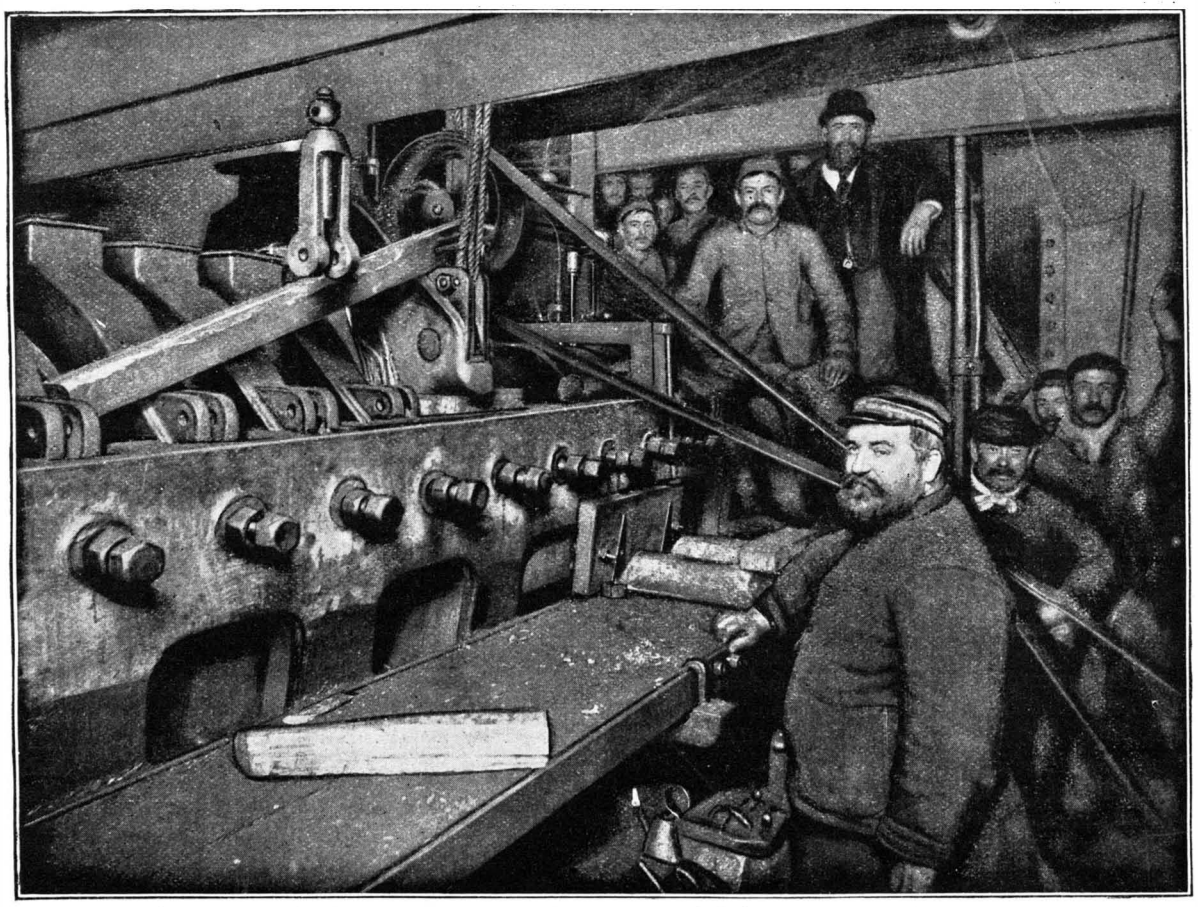

Fig. 4.—STEAMER UMBRIA—THE DUPLEX DRILLING MACHINE AT WORK.

The thrust collar boxes are seen at the left. In the foreground is Second Engineer William Frazer. Above him is Mr. Duff, of Reid & Duff.

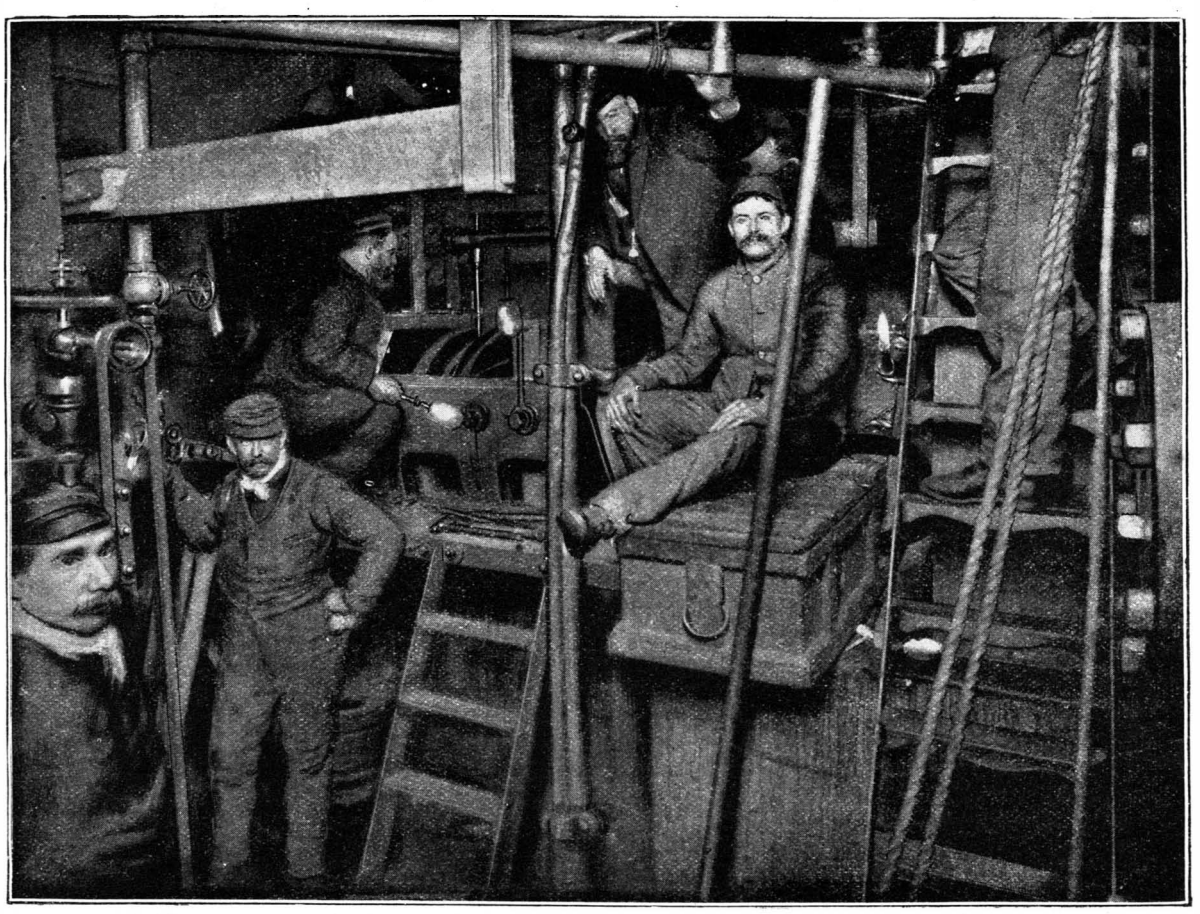

Fig. 5.—STEAMER UMBRIA—VIEW OF THE DRILLING MACHINE AND MAIN SHAFT.

The drawings were made at once by Mr. Lawson, the draughtsman of the Dumbarton Iron Works, and the work put in hand, the men working in shifts, day and night. The work consisted in the cutting out of 26 inches of the length of the shaft and inserting a new section, with collars to match the collars on the shaft, with keys across and between the faces, and the whole strongly bolted together.

The first work, that of cutting out a section of the broken shaft of 25 inches in diameter, 26 inches in length, involved the construction of a special duplex drilling machine and the putting into the hold of the ship of a temporary engine and steam connections. This was all accomplished and the machine set to work in two days from the arrival of the steamer at her dock.

The drilling machine, so quickly hurried together, is illustrated in Figs. 4 and 5. It consists of a cast iron frame with two cross bars and flanged feet for bolting to and adjustment on the two cross frames, which were fixed by clamp bolts to the thrust block frame. The drill frame carries two vertical spindles, with 1⅜ inch drills, 26 inches apart on their outside measure, just clearing the face of the thrust collars to be used for bolting to the new shaft section. The vertical spindles have each a worm gear, diriven by worms on a horizontal shaft, to the end of which is a pulley and belt, connected with the portable engine upon the floor of the shaft compartment, each drill being fed by a screw, as shown in Figs. 3, 4, 5, 6, and 11.

The adjustment of the position of the drilling machine upon the slotted guide frames allowed of exact spacing and direction of the boring. Every alternate hole being first drilled, the holes were plugged with iron rods, and the intermediate holes then drilled, cutting slightly into the plugs. When seven holes were finished to the center, the shaft was turned over and the opposite holes drilled. The shaft was turned a quarter over and fifteen holes on opposite sides were drilled, and then the corners drilled out, thus requiring the turning of the shaft and engine eight times by the turn-over engine.

The starting of the holes on the slope of the curve was done by chipping recesses at the proper places while the drilling machine was running in adjacent holes. This work required a length of nearly 800 lineal inches of 1⅜ inch holes, occupying 7 days of 24 hours each, when the piece was lifted out, and appeared as shown in our photograph, Fig. 7, and cut, Fig. 8. The faces of the shaft ends were then chipped even with the collars. This machine weighed about 1,000 pounds. The next operation of drilling the 12 lateral holes for the 3 inch bolts in each collar required the construction of a new and special drilling machine with gears driven from the portable engine, the frame of which is clamped to the iron ways fixed across and above the shaft. These ways have slots by which the three different machines that in turn are placed upon them are adjusted in position and bolted fast.

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The drilling machine carries a spindle on which is a spur gear and feed screw with a right hand cutting drill at one and a left hand drill at the opposite end, by which two holes are drilled at once. This machine is shown in Fig. 11. The drilling of the 24 holes for the 3 inch bolts, two opposite holes being drilled at once, occupied 3 days of 24 hours each, including the turning over of the shaft 12 times. The machine weighed about 1,200 pounds.

A new and special machine was also made for milling the keyways across the face of the ends of the shaft, including the thrust collars, each 36⅜ inches in length, 4 inches wide by ¾ of an inch in depth. When it is considered that the distance is only 26 inches between the faces of the cut shaft and that the sides and under side of the shaft are covered by the frame of the thrust block, this machine becomes a most important device for the execution of this work in the shortest possible time. It is of a novel construction, and like the other machines is driven from the portable engine belted to a pulley on a horizontal shaft, with a worm gear actuating a vertical feathered shaft; a horizontal double head spindle actuated from the vertical shaft by worm gear carries two cutters (right and left) and moves vertically on two guide rods by a feed screw. The moving parts are mounted on a solid frame, which is bolted to the slotted cross ways before described, and made adjustable exactly to the proper lines of the keyways to be cut, so that the machine will traverse the two cutters from the periphery to the center of the shaft without readjustment. The shaft is then turned one half over for cutting the opposite ends of the keyways. The machine weighs about 1,000 pounds and is shown in Fig. 12.

The bolting of the new section to the thrust collars of the shaft is by 24 3-inch bolts, with nuts at each end, 7 inches in length between the nuts.

The weight of the new section, with its keys and bolts, is over 2 gross tons. Its handling is no easy matter.

The boring of the collars of the new section is shown in Fig. 9 as it appears upon the drill press at the works of the Paterson Iron Company, Paterson, N. J., where it was forged and finished in ten days. In our next we hope to give a photo. of the shaft as it appears with the new section in place complete.

The present repairs are only a temporary arrangement, made to enable the ship to return to England, where, as stated, an entire new shaft has been ordered.

The loss of the use of 6 out of 13 thrust bearings, one being for a supporting strap, which is to be put on here to prevent any sagging of the shaft, will necessitate a reduced speed on the home trip, which is expected to be accomplished in about nine days.

Our acknowledgments are due to Vernon H. Brown, Esq., the able representative of the Cunard Company in this city, for permission to visit the ship and make drawings and photographs; also to Captain McKay and Engineer Tomlinson and his aids for their courteous assistance; also to Messrs. Reid & Duff and Mr. Benjamin S. Lawson, of the Dumbarton Iron Works of this city, and Mr. Johnson, superintendent of the Paterson Iron Works, New Jersey.

Our engravings have been chiefly prepared from photographs specially taken for the SCIENTIFIC AMERICAN by our photographer, Mr. F. D. Palmer. The dark and narrow spaces in the lower depths of the great steamer, where the work of mending the shaft was done, rendered the picture taking a difficult job. It was accomplished by means of the magnesium flash light and persevering effort on the part of the photographer.

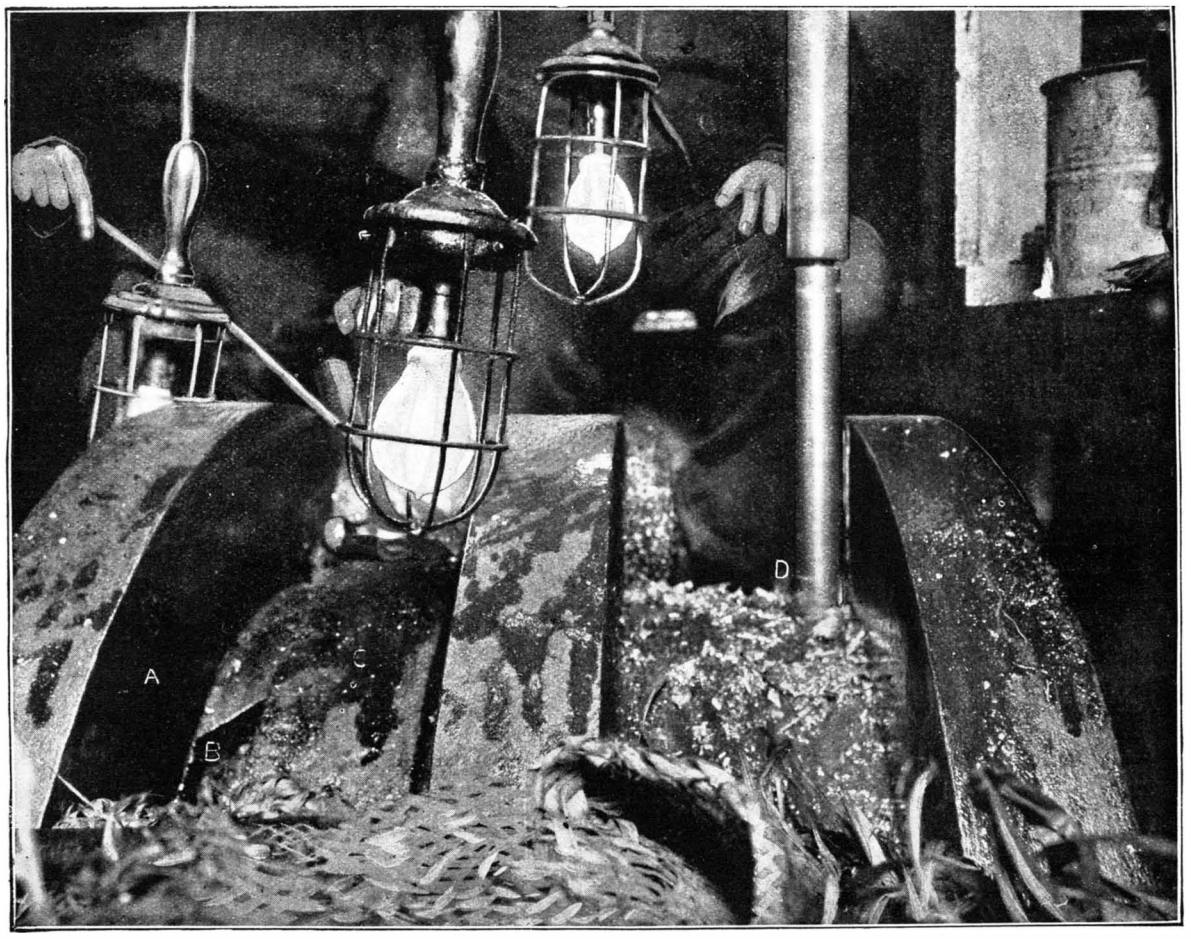

Fig. 6.—STEAMER UMBRIA—VIEW SHOWING THE BROKEN SHAFT AND THE DRILLS WORKING THEREON.

A. Collars on main shaft. B. The crack in the shaft. C. Band covering the crack. D. One of the drills.

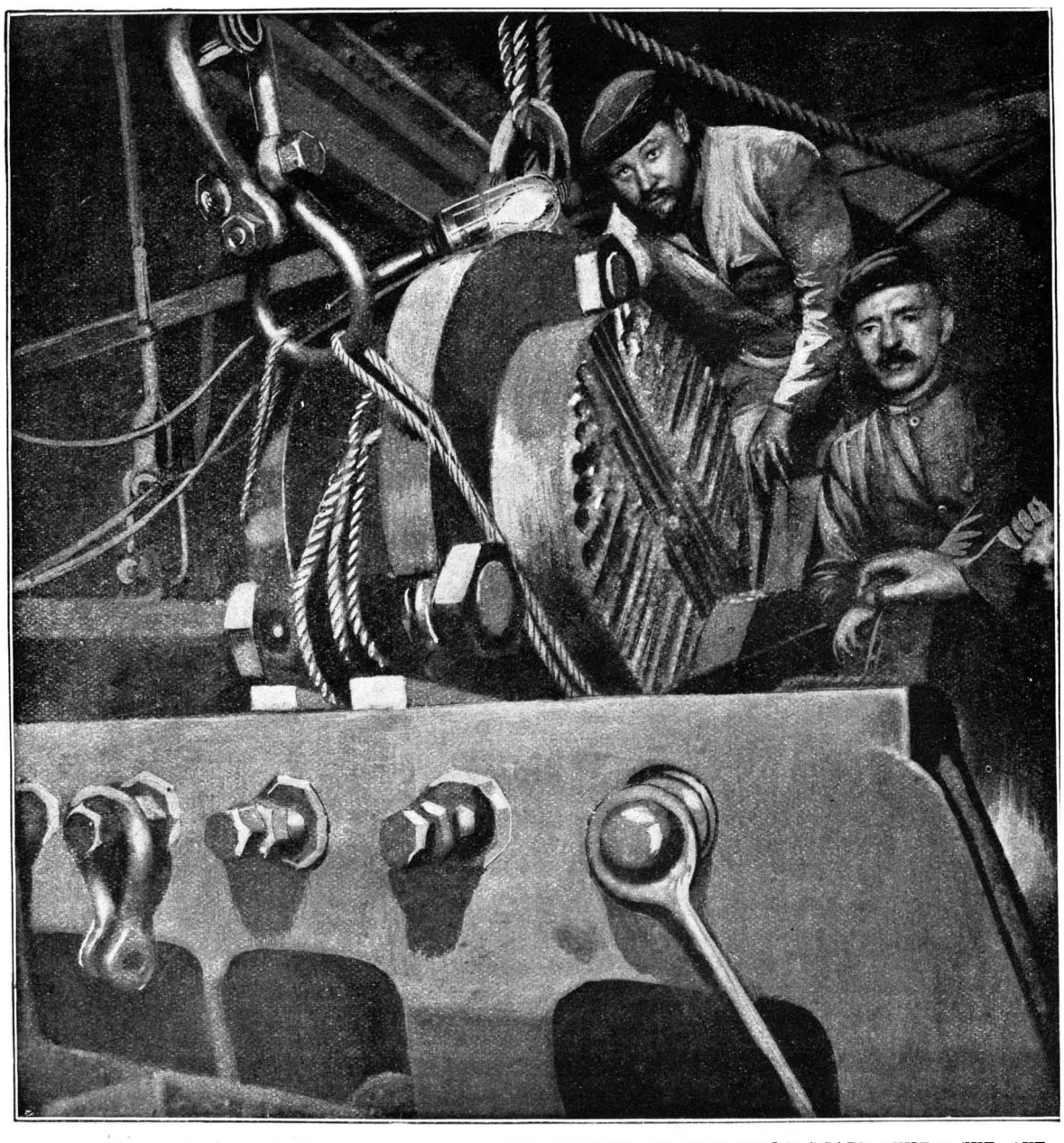

Fig. 7.—STEAMER UMBRIA—SHOWING THE BROKEN SECTION OF THE MAIN SHAFT WHEN CUT OUT AND LIFTED UP.

We give likenesses of some of the men whose energy and skill, under the direction of the commander, brought the Umbria safely to port under the most trying circumstances, assuring her passengers of safety of life and rescuing her owners from a burdensome salvage. A breakdown at sea at any time and in fair weather is a nerve-straining event; but when to this is added the raging of one of the severest storms of years, rolling and pitching a ship upon its angry waves, the work of repair becomes a desperate battle for life; but cool heads and the temporary appliances at hand enabled the work to be done in a way that allowed the ship to save hereself by steaming slowly to her port of destination.

The successful efforts of the Umbria's engineers was pleasantly recognized a few days ago by the American Marine Engineers B. A. in the form of a dinner given to Lawrence Tomlinson, chief engineer, and William Frazer, Charles Forrest and Henry C. Paterson, his assistants.

President Van Arsdale welcomed the guests in the name of his association, which, he said, had decided to present each with a token of its appreciation of mechanical and engineering skill shown under very trying circumstances. The presents consisted of engrossed resolutions and chronometers.

Mr. Tomlinson thanked his hosts for their kind token, but he had only done his duty, he said, and the word duty ought to be the watchword among all engineers.

He said that when the breakdown occurred on the Umbria, he and his assistants tackled the job with meekness and humility. They felt that they had done it well, after putting in 72 hours' time in making the necessary repairs. Their anxiety was intensified in the circumstances of the breakdown, but their duty was doubled. However, they did not imagine that they would win so much fame on shore.

Mr. Tomlinson then proceeded to give a brief account of the fracture, the shaft and the work of repairing. The crank and shaft came forward, and the engineers heard a rattling. On stopping the engines they found the break in the shaft, and first wanted to put in five bolts, but decided on three. They cut one of the collars of the

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shaft, and this was a serious piece of business with the tools they had. It took twenty-four hours to put in one bolt.

Chief Engineer Lawrence Tomlinson, whose portrait we give, was born in Liverpool in 1836, entered the service of the Cunard Company as a boy in 1854; served seven years apprenticeship at engineering, and continued in service as a journeyman, entering sea service in December, 1861, making his first voyage to sea in the celebrated side wheel steamer Persia as junior engineer. Up to the present time he has seen continued service in various engineering capacities for a period of over forty years.

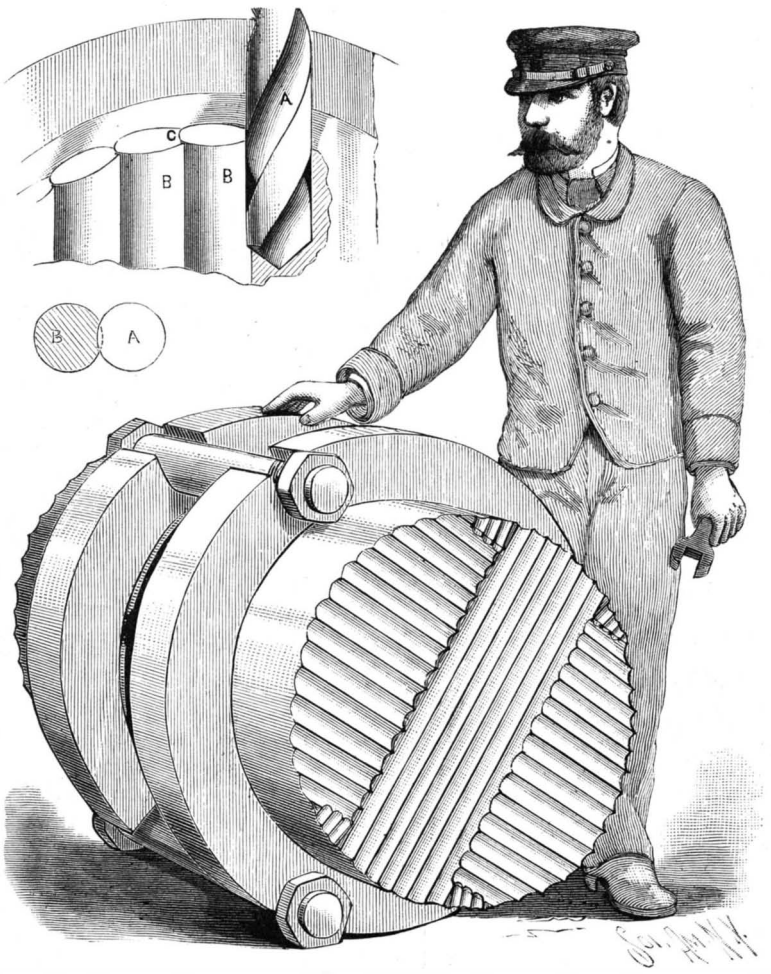

Fig. 8.—STEAMER UMBRIA—SHOWING THE DRILL CUTS IN SHAFT SECTION.

Large Lake Steamers.

There have just been laid down at the yards of the Globe Shipbuilding Company, of Cleveland, Ohio, the keels of two steamers which are designed to be not only the fastest ever seen on the lakes, but the forerunners of an intercontinental system of transportation between this country and the Orient. The two ships are intended particularly for the passenger service between Buffalo and Duluth, and their speed is to be not less than 20 miles per hour. They are intended to make the run between Buffalo and Duluth in 50 hours. Their general dimensions are: Length over all, 380 feet; beam, 44 feet; and depth of hold, 34 feet. The draught when running in the open lakes will be 18 feet. This will be obtained by filling water compartments in the double bottom space. On entering the Detroit flats the draught will be brought up to 16 feet by pumping out the compartments. The increased draught will afford in the open lakes enhanced speed. The two vessels are building for the Northern Steamship Company. They will be the first steamers on the great lakes to be provided with quadruple-expansion engines, and their horse power, which will be 7,000 for each ship, will exceed by 3,000 the maximum horse power now developed on the lakes. The engines will embrace cylinder diameters for the four cylinders of 25, 36, 51½ and 74 in. The stroke will measure 42 in.

The Inventors of the Telegraph.

Prof. Thomas Gray, of Terre Haute, Ind., celebrates the beginning of the second century of the American patent system by an address on the "Inventors of the Telegraph and Telephone," giving in succinct form the history of these inventions. From the discovery of Stephen Gray in 1729 that electrical influence could be conveyed to a distance by insulated wire, of Romagnesi in 1805 of the deflection of a needle, rediscovered by Oersted, to the inventions of Schweigger and Schilling and Steinheil, up to Morse, the gradual evolution of the telegraph is traced. The influence of the researches of Prof. Henry receives adequate recognition in this paper, and his claims are quoted:

"1. Previous to my investigations the means of developing magnetism in soft iron were imperfectly understood, and the electro-magnet which then existed was inapplicable to the transmission of power to a distance.

"2. I was the first to prove, by actual experiment, that in order to develop magnetic power at a distance a galvanic battery of 'intensity' must be employed to project the current through the long conductor, and that a magnet surrounded by many turns of one long wire must be used to receive this current.

"3. I was the first to actually magnetize a piece of soft iron at a distance, and to call attention to the fact of the application of my experiments to the telegraph.

"4. I was the first to actually sound a bell at a distance by means of the electro-magnet.

"5. The principles I had developed were applied by Dr. Gale to render Morse's machine effective at a distance." Which is the better known name, asks Prof. Gray, that of Henry or Morse? and he pertinently adds, "Would not Henry have gained, both in popularity and in scientific reputation, if he had patented and made the public pay liberally for his discoveries?"

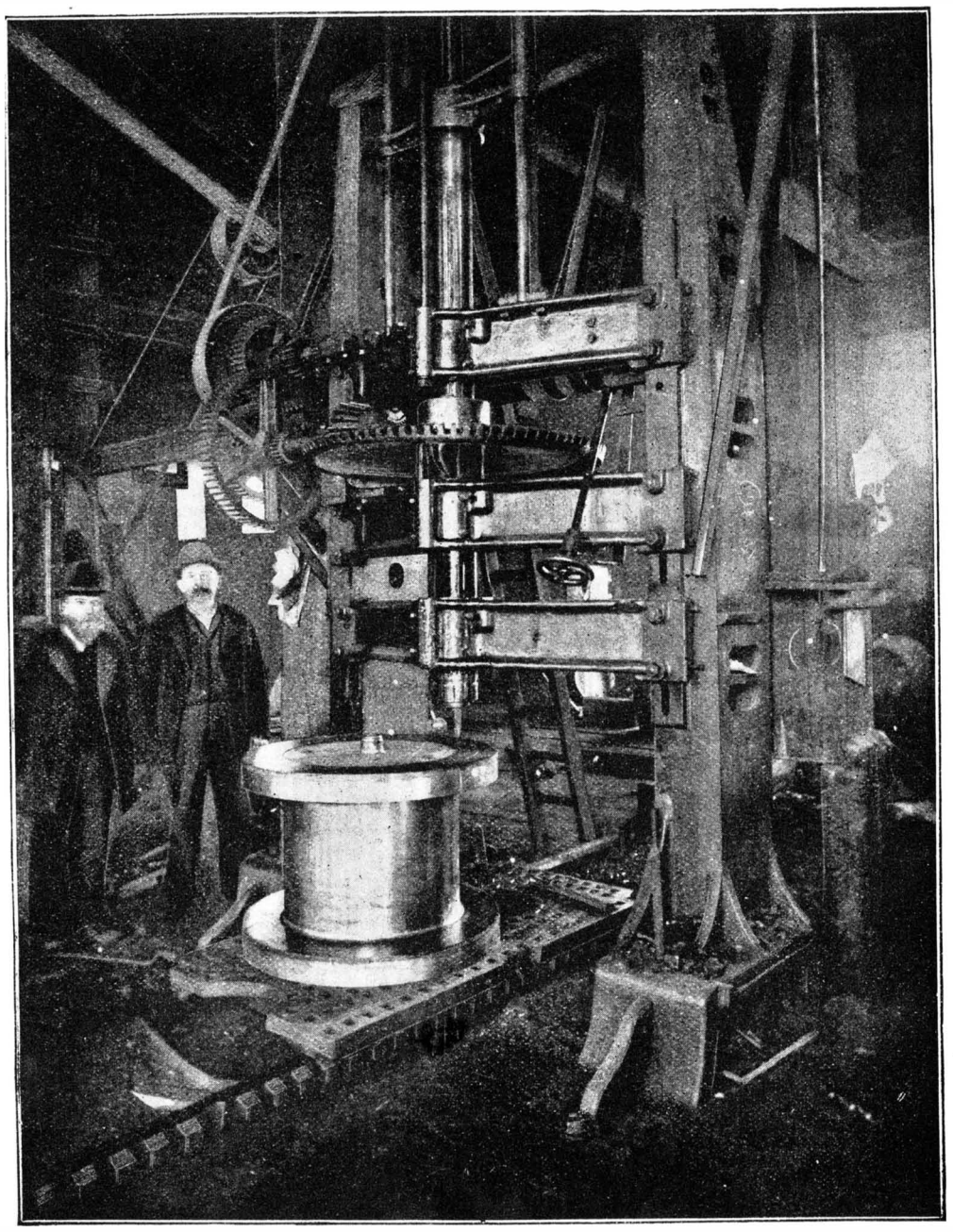

Fig. 9.—STEAMER UMBRIA—BORING THE COLLARS OF THE NEW SHAFT SECTION, PATERSON IRON WORKS.

Meteoric Photography.

While photographing the Holmes comet at Ansonia, on the evening of the 13th inst., John E. Lewis, an astronomer at Ansonia, Conn., was startled by a bright light at about 7:30 o'clock. Upon developing the plate, which had been exposed to the constellation Andromeda for twenty-three minutes, the trail of a large meteor was discovered across the center.

The trail runs a little south of Beta Andromeda, and almost directly over Andromeda, and lies in a northwesterly direction. This meteor was seen by several persons within a radius of twenty miles of Ansonia, and is described as intensely bright, the illumination being very vivid. It was seen to break, but was evidently too far away for the detonation to be heard.

It is hoped that persons who may have seen the meteor and can describe its apparent path with some degree of correctness will communicate with Mr. Lewis or Professor H. A. Newton of Yale University. Another observation of the meteor's path from a distance would have given all the data necessary to determine the height of the meteor above the earth's surface, a very important and uncertain question at present.

Aluminum.

As compared with most metals, pure aluminum, according to a recent article by Mr. A. E. Hunt, of the Pittsburg Reduction Company, under ordinary circumstances, withstands the action of wind and weather exceedingly well, but the presence of silicon greatly reduces its resistance to atmospheric influences. Metal with 4 per cent or 5 per cent of silicon very soon collects a thick coating of oxide upon it, if severely exposed. Aluminum can be rolled or hammered cold, but the metal is most malleable at, and should be heated to, between 350° and 400° Fah., for rolling or breaking down from the ingot to the best advantage. Like silver and gold, aluminum has to be frequently annealed, as it hardens up remarkably upon working. Due to this phenomenon of hardening during rolling, forging, stamping, or drawing, the metal may be turned out very rigid in finished shape, so that it will answer excellently well for purposes where the annealed metal would be entirely too soft or too weak, or lacking in rigidity, to answer. Especially is this true of aluminum alloyed with a small percentage of titanium, copper, or silicon. It can be safely stated as a general rule, that under similar conditions, the purer the aluminum, the softer and less rigid it is. Aluminum can be annealed by heating and allowing it to cool gradually. The best temperature is just below the red heat. Thin sections can be annealed by heating in boiling water. Aluminum can be easily and readily welded by electrical apparatus, and a cheap and satisfactory solder has been discovered. Sound castings of this metal can be made in dry sand moulds or metal chills. It requires, however, some experience to master its peculiarities before sound castings can be uniformly made. The aluminum should not be heated very much beyond the melting point; if too hot, it seems to absorb gases, which remain in the metal, preventing sound castings.

Dangerous Hailstones.

A correspondent of the *Morning News*, Dallas, Texas, describes a great rain and hail storm which took place at Gray Hill, Texas, on December 6. This remarkable hail fell in large lumps, ranging from three to six inches in diameter. I heard of one piece eight inches in diameter, which weighed four pounds. They were, as a rule, spherical in form, but some were somewhat flat, and nearly all were covered with oval knobs. The fell in small areas, about two feet apart, while in other places only one would fall in a space twenty feet square. The average under my observation was about one hailstone to every three feet square. A most remarkable fact in connection with these large hailstones is that some of them have particles of dirt in the center. The question is, How did they get there?

ELECTRIC wands are now used for beast taming.

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Electrical Action in Photographic Development.

In a recently published number of *L'Amateur Photographe*, Mons. L. Mathet describes some experiences of electrical action in the development of celluloid films. He noticed in developing some films of his own preparation a phosphorescence-like appearance on the surface of the negative, a phenomenon which also appeared when he repeated the experiment with rollable films of commercial manufacture. The circumstances under which the phenomenon appeared in the latter case were as follows: The films were developed in an ordinary vulcanite dish, with pyro-soda. While flowing the developer to and fro over the film he clearly noticed, he says, a phosphorescent gleam upon its surface. When development was complete the developer was removed, the film allowed to adhere to the bottom of the tray, and flooded with the wash water, when the mysterious light became even more apparent. The negative, when fixed, was slightly veiled. Substituting a hydroquinone developer for the pyro-soda with other exposed films, the same "phosphorescence" appeared and subsequent slight fogging also supervened.

Mr. Mathet regards these experiences as confirming the conclusions of Colonel Waterhouse (see the last volume of this *Journal*), that an electro-chemical action is producible during development; but in M. Mathet's case this action is made apparent by the nature of the support. That gentleman, however, points out, what of course is tolerably well known, that celluloid is a bad conductor of electricity. When talcked glass is coated with a solution of celluloid in amyl acetate and the dried film is stripped, a shower of small electric sparks is evolved between the detached film and the glass at the moment of separation. The pellicle, however, retains its electrical properties.

In coating large surfaces of rollable celluloid films M. Mathet points out a fact which we remarked upon some years ago, although the statement encountered the dubiety of an experienced dry plate maker, that this non-conducting property of the celluloid may lead to the fogging of the superposed emulsion, the entire surface being fogged, and the discharge becoming visible on development. M. Mathet is inclined to think that the same phenomenon is the cause of the several small stars with which some of his film negatives were disfigured. He quotes the case of a commercial film which, upon development, showed a dark spot around which were formed certain regularly defined luminous radiations that he also sets down to the same cause.

M. Mathet states that if the celluloid film be coated while on a metallic surface, instead of a glass plate, as is generally used, sparks are produced if the film is forcibly moved in contact with the metal, and especially if the air be dry, while they may be avoided if the atmosphere be humid and care be taken to remove the pellicle carefully, and placed in contact with some inert material. Such facts are no doubt thoroughly known and understood by commercial manufacturers of celluloid films. The interesting point in M. Mathet's communication lies in what he regards as a confirmation from his own experiences, that, as Colonel Waterhouse and others have already discovered, an electrical action is produced in development. It should, however, be pointed out that in Colonel Waterhouse's experiments, if we remember aright, no sparks of electricity were visible.—*Br. Jour.*

Fig. 10.—LAWRENCE TOMLINSON, CHIEF ENGINEER OF THE ROYAL MAIL STEAMER UMBRIA.

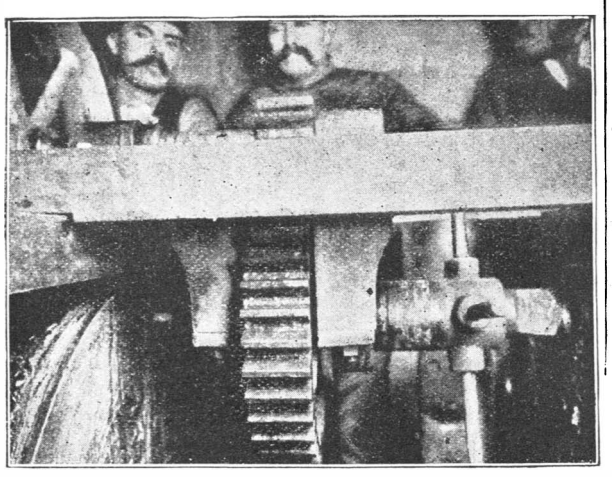

Fig. 11.—STEAMER UMBRIA—THE LATERAL DRILLING MACHINE BORING THE SHAFT COLLARS.

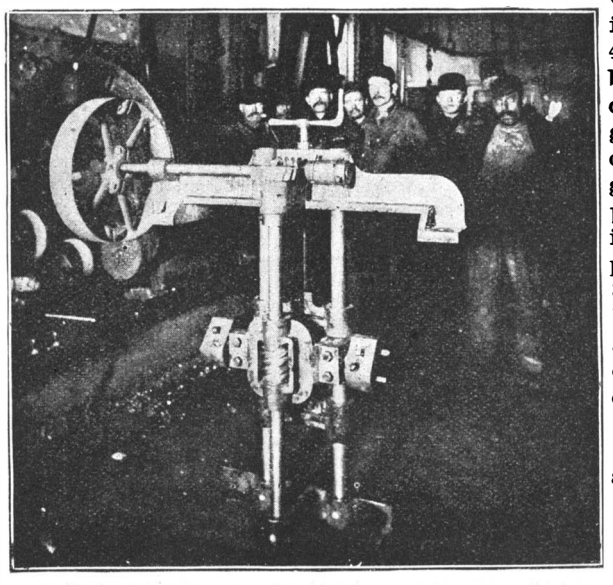

Fig. 12.—STEAMER UMBRIA—THE SPECIAL KEYWAY CUTTING MACHINE.

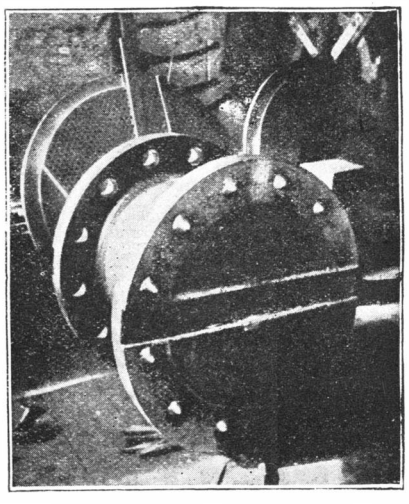

Fig. 13.—THE NEW SECTION OF SHAFT, SHOWING THE KEYWAY AND BOLT HOLES.

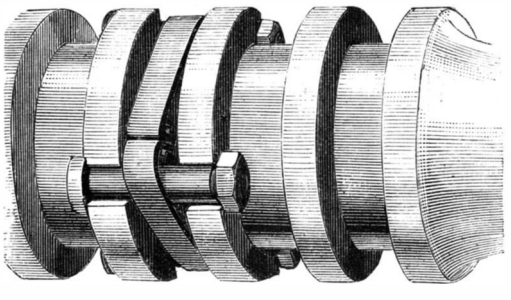

Fig. 15.—THE BOLTS STRAPPED IN PLACE.

Cold and Ether.

That extreme cold paralyzes every vital function is, of course, a piece of every-day knowledge. But it has been left to Professor Pictet, who has been conducting some experiments on this subject, to discover that at a temperature of 150° below the Centigrade zero there is no chemical action between nitric or sulphuric acid and potash, or between oxygen and potassium, though under ordinary circumstances the affinity of the latter metal for oxygen is so great that it will burn if thrown into water, owing to its combination with the oxygen in that fluid. But if the electric spark is played on bodies which have thus lost the power of chemical affinity, some new and curious combinations result. The latest investigation, the conclusions of which, however, have been theoretically presaged for some years past, may require us to reconsider the question of the temperature of outer space and the possibility of an atmosphere composed of gases in combination existing there.—*Daily Chronicle.*

The Water Jet.

The *Genie Civil* describes the sinking of iron piles in Chile with a water jet. Some of the piles were 14·76 in. in diameter, with a flat bottom flange or pedestal 41·92 in. in diameter, and were sunk to a depth of 28 ft. below the bottom of the river through a very coarse, compact sand, in which screw piles penetrated with great difficulty, and sharp piles could only be driven 11·8 to 14·1 ft. A pump delivering about 12,000 gallons per hour through a 4·92 in. pipe would sink two piles, each having a 2·05 in. pipe projecting about 7·87 in. below its base with a 5·9 in. opening. The pile being put in position and the water jet started, it sank nearly 3 ft. by its own weight, after which it was worked down by means of an endless cable leading from the drum of a hoisting engine around a horizontal pulley bolted on to the pile so as to revolve the latter about its vertical axis. An average of eighteen hours was required to sink each pile. On one side of the river a double action Worthington pump was used, and on the other a Tangye pump.

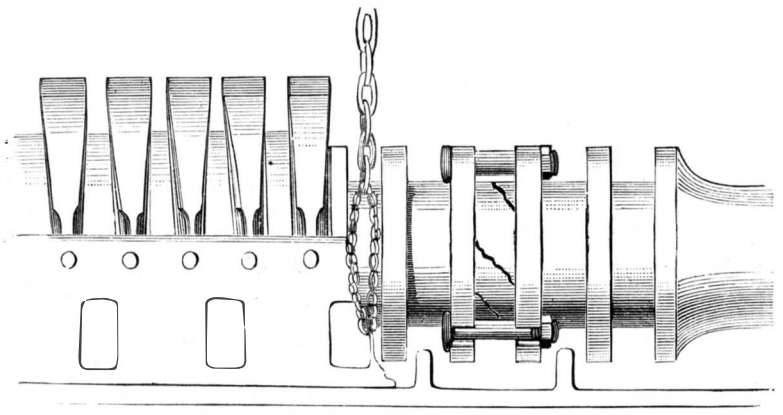

Fig. 14.—THE BROKEN SHAFT OF THE UMBRIA AS REPAIRED AT SEA.

THE highest chimneys in the world are two in Glasgow, one being 468 feet high and the other 455 feet, while one near Cologne comes next with a height of 441 feet.

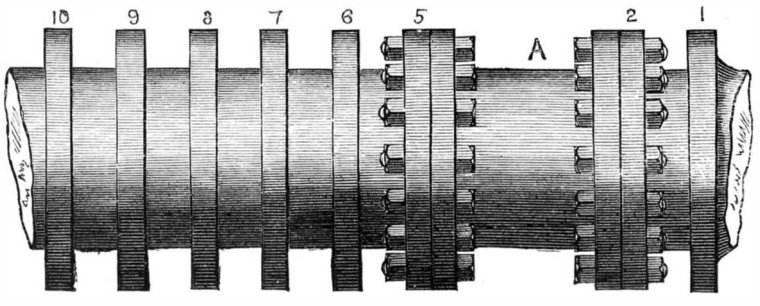

Fig. 16.—THE FINAL REPAIRS OF THE UMBRIA'S SHAFT.
A shows the new inserted section.

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RECENTLY PATENTED INVENTIONS.

Engineering.

LOCOMOTIVE BOILER.—Jos. S. Newlin, Fairfax, S. C. A portion of the boiler flues passing the hot currents from the fire box to the smokestack have, according to this invention, return ends, made thick and heavy to permit hammering without damage, by which the currents are returned backward and then forward again through other flues to the smokestack, thus securing a much longer travel of the hot currents through the boiler and a better utilization of the heat. A novel means is provided of putting in the return ends firmly, in a simple and inexpensive way.

STEADYING PORTABLE ENGINES.—Edward C. Emde, Tacoma, Washington. To prevent undue shaking of the machinery this invention provides a steadying device with a base, on which are adjustably held two legs adapted to engage the axle or wheel of the engine, one of the legs being made in sections fitted to slide one on the other. The device is applied preferably on the hub or axle of each rear wheel of the portable engine, when it securely and firmly steadies the entire machine, preventing undue shaking and holding the engine in position to prevent slack of the driving belt, etc.

Railway Appliances.

SIGNAL LANTERN.—Willey J. Fellhemer, New York City. This is a simply constructed, durable, and inexpensive lantern, especially adapted for use on railroads or on shipboard. It normally shows a white light, but surrounding the globe or chimney are screens of flexible material, transparent, translucent, or semi-translucent, and colored as the code of signals may require. Means are provided whereby the screens may be independently manipulated, to conveniently carry any one of them in line with the rays of light to display a light of its special color.

CAR COUPLING.—Joseph B. Hulett and Louis J. Beers, Middletown, N. Y. According to this invention the link is held in substantially horizontal position, to be automatically guided into an opposing drawhead, the link having also a limited up and down and lateral movement, while a hook-shaped pin maintains the link in place, a weight being arranged to hold the pin normally in coupling position, when it will automatically engage a link entering the drawhead. The hook-like pin may be readily removed, and the coupling may then be used as the ordinary link and pin coupling.

Electrical.

LAMP HANGER.—Charles S. Hume, Detroit, Minn. This is a simple device to facilitate the raising or lowering of an electric lamp in a room or other location, and holding it in desired position. The light wire, having on its lower end the lamp, extends from a ceiling support, and to it is tied a string, connected with a pendent rod and supporting frame, in which is a spring-controlled pulley, around which the string is wound. The tying of the string at different points on the light wire controls the limit of raising and lowering the lamp, which is simply pulled down to the desired position, when the parts counterbalance the tension of the spring so that the lamp remains in place until pushed up.

ELECTRIC RAILWAY CONDUIT.—Chas. A. Stark, Duluth, Minn. This improvement comprises a surface conductor, arranged adjacent to which and adapted to connect an electric current is a circuit closer, a compressible track rail, and means for operating the circuit closer by means of the rail. By this means the trolley conductor is carried upon the surface of the ground, the line conductor beneath the surface, and the circuit is closed through the trolley conductor only at the points opposite the car, the construction enabling the line conductor to be safely carried without danger of grounding and reducing the liability to accidents, as under ordinary circumstances the trolley wire or conductor will carry no electricity.

GALVANIC BATTERY.—Wm. R. Reud, New York City. This is a battery to be worn upon or applied to the person to send a mild current through certain diseased parts to stimulate and strengthen them. It has an outer perforated cylindrical copper shell forming one pole, an inner zinc cylinder forming the opposite pole, an insulating base or plug secured to the two poles, and a button secured to the outer end of the plug and connected by a conductor with the inner pole. The battery is held in the hand to any affected part, when the perspiration and acids of the body acting on the battery poles are designed to produce a mild current, a stronger current being obtained by dipping the battery in vinegar or other acid before applying it to the body.

Mechanical Appliances.

VALVE.—Thomas P. Ford, Brooklyn, N. Y. This is a valve more especially designed for use on hydraulic elevators and other machinery to insure the perfect seating of the valve. On the extreme upper end of the valve stem is a piston sliding in a cylinder, in the cap of which is a port leading to another cylinder with a valve seat for an auxiliary valve normally held on its seat by a spring, and controlled by a fluid under pressure, the main valve being automatically controlled by the fluid.

KNITTING MACHINE.—Julius Frelloehr, New York City. This machine is designed to form very fancy trimmings in a simple and effective manner. It has reciprocating needles and binding thread guide bar to guide the binding threads to the knitting needles, while pattern thread guide bars slide longitudinally to carry the pattern threads across the binding threads, one of the pattern thread guide bars being also mounted to swing or turn, to move its pattern threads above or below the threads carried by the other pattern thread guide bar.

ROLLER COTTON GIN.—Wiley E. McCall, Jasper, Fla. This is a simple, durable, and effective machine, designed to be run by foot power. The mechanism for separating the cotton from the seed is not new, but the improvement provides for conveniently operating the machine, while the operator may at the same time feed the necessary quantity of cotton. Heavy flywheels give the machine a uniform and steady motion.

Agricultural.

CULTIVATOR.—Alexander J. Bolster, York, Neb. This is an arch cultivator, in which the gangs are located forward of the arch, so that their operation may be readily viewed by the rider, provision being also made for readily elevating the cultivators and locating them near the wheels of the machine. The axles are also so located upon the arch and the cultivator gangs upon the axles that they will move together, while the wheels may be turned to the right or left to reduce the width of the machine, the gangs sustaining the same relation to the wheels at all times. The gangs are brought close to the forward portion of the wheels as well as close to the team, thereby lessening the draught.

DISK CULTIVATOR.—This is a further invention of the same inventor, covering an improvement according to which the disks may be run forward of the arch of the cultivator, and are so located that the driver may observe their action on the ground, stopping to uncover a covered up hill if desired. The disks thus located are designed to form a perfect balance under all conditions, their weight when raised out of the ground being forward of the arch, and preventing the pole or tongue from being lifted up.

COTTON CHOPPER AND CULTIVATOR.—Eugene M. Nolan, Jacksonville, Fla. The construction of this implement is such that the hoes are carried in connection with cultivator blades, and both the hoes and blades may be raised and lowered either independently or collectively. Novel means are also provided whereby two hoes may be made to operate conjunctively transversely of the implement, a diagonal cut being made on the ground as the implement advances, while after the first cut the rear hoe will cross diagonally the cut made by the forward hoe, thus producing a series of closely grouped diamond-like spaces in which the cotton is left. The hoes may be entirely removed when the cotton has been properly thinned, and the cultivator only used for working the cotton.

MILK CAN.—Emile Plancon, Brooklyn, N. Y. This can has at the top of the vertical portion of the can, where the diameter is of full size, an annular pendent exterior fold, which is elastic to such a degree as to serve in the capacity of a cushion, strengthening the can against any strain or force that may be exerted upon it. The can is also adapted for general uses, and as no soldering or extra pieces are located at the flange, the expense of manufacturing is materially reduced. The flange is made by bending the metal upon itself to form an outer, downwardly extending, cylindrical fold upon that portion of the breast of the can which engages its body.

CHURN.—Silas J. Saxon, Colfax, Washington. This churn has an upright cylindrical body, and is adapted to be actuated by an operator turning a crank shaft, which sets in rapid motion a dasher which generates rotary currents, these being obstructed and checked by fixed abutments or wings, so that the cream is quickly churned and butter rapidly produced. When the butter is to be removed, the cover, center shaft, and dasher are lifted out, and the churn and dasher may both be very quickly cleaned.

MANUFACTURE OF BUTTER.—David W. Hudson, Frank La Strong, and George D. Bunch, Los Angeles, Cal. This invention provides for the manufacture of a composition butter, of milk, cocoanut oil, and pure butter, after a described process, to largely increase the bulk or weight of the butter without destroying its original virtues.

Miscellaneous.

VENDING MACHINE.—Joseph A. Poff, Lawrence, Kansas. This is a coin-operated machine for automatically selling postage stamps, envelopes, and similar articles. A draw slides in a casing to carry outside the article, while a coin-receiving lever movable back and forth with the drawer locks it normally in position, the lever being moved to unlock the drawer on the deposit of a coin. The construction is simple and durable, and is designed to prevent tampering with the contents of the casing.

TYPE SETTING MACHINE.—Hayden C. and Samuel D. Snoddy, Greenville, Ky. In this machine a series of channels or magazines hold the type until they are dislodged by ejectors operated by keys, an intermediate carrier frame receiving the type until the number necessary for a line is accumulated, when the type is moved up into a row at one end of the carrier and dropped into the galley by the same operation which sets up the type in the carrier for the next row. Type of the ordinary kind is used without mutilation or injury, and means are provided for spacing and justifying the lines automatically as they are set.

HOT WATER HEATER.—Micheal E. Herbert, St. Joseph, Mo. The boiler of this heater has a hollow top section with a depending water leg, longitudinal circulating bottom pipes being connected with the top by vertical tubes, while a tubular grate section communicates with the water leg. The construction is quite inexpensive, and the boiler is designed to be a positive, rapid, and economical heater for any grade of fuel.

BRICK KILN.—John B. Griswold, Zanesville, O. This is an improvement on a formerly patented invention of the same inventor, the flues being so arranged that the kiln is operated on a combined up and down draught, the intense or direct heat being driven against the lower sides and under the floor of the kiln, to produce radiated heat, and then up into the center of the kiln through flue openings in the bottom, and providing for a complete and even distribution of the intense heat to the ware most in need of it. Simple means are provided for deflecting the heat, to cause a greater or less heat to travel up the side flues into the kiln or under the floor, or more to one portion thereof, as may be desired.

BUILDING BRICK.—This is a further patent of the same inventor for a rock-face brick, its exposed face being formed with smooth outer edges, and a central smooth-faced rib connecting the upper and lower edges. The rock-faced portions of the brick thus formed are depressed panels, produced by a suitable mould against which the edge of the brick is pressed by hydraulic or other pressure preparatory to its being burned. The central ridge enables the brick to be cut to advantage for finishing out the ends of courses or becoming a corner brick, avoiding the necessity of breaking joints, and giving a beautiful and finished appearance.

BASE HEATING STOVE.—Richard L. Ball, Terre Haute, Ind. This improvement is especially applicable to stoves using gas for fuel, affording a cheap and simple stove designed to generate and radiate a large quantity of heat in proportion to the amount of fuel consumed. The combustion chamber has an open front and an inclined double wall at the back, and a hollow radiator is arranged upon the case top and connected with the combustion chamber, a damper-controlled passage leading from the radiator to the smoke pipe, while air pipes lead upward through the double wall of the combustion chamber and deliver into the receptacle of the radiator and through the case top.

CALCIMINING MACHINE.—Wm. Peterson, Sheboygan, Wis. A tank with a handle and having journaled at its ends wheels adapted to run upon a ceiling is connected with yielding distributing rollers, adjacent to which are brushes, while there is an operative connection between the brush mechanism and the rollers, so that the rotation of the latter drives the pump. The tank holds a large amount of calcimine, whitewash, or other liquid, and by pushing the machine over a ceiling or wall the liquid is nicely and evenly applied, with great rapidity, none of the liquid being spilled.

CONVEYER.—Charles W. Renau, Meridian, Miss. This improvement embraces especially the couplings for conveyer sections, the tubes and their flights being of ordinary construction, and the coupling sections and journal sections being detachably connected. The coupling section has for the tube end a seat formed of a corrugated space or groove into which the conveyer tube may be pressed, and the journal section has a head fitted to a socket, in which it may be inserted laterally, while it cannot be moved in or out in the direction of the length of the journal and coupling sections.

VEHICLE SEAT.—John Ruch, Mount Eaton, Ohio. This is a seat especially adapted for two-wheeled vehicles, such as road carts, and has a hinged back and novel connections between the seat and the vehicle body. Means are provided for shifting the position of the seat back, to render the seat easy, and that it may also be adjusted to bring the weight of the load in the right position in relation to the wheels, enabling the vehicle to be properly balanced to ride and draw easily.

WAGON BOLSTER STANDARD.—Anthony Miller, Cape Girardeau, Mo. This is a combined ferrule and standard, the ferrule fitting upon the bolster and having parallel wings upon its outer end, the wings connected at the top and outer edge by a rib, while pivoted between the wings is the standard, having a depending shank to strike the end of the bolster, its back striking the rib connecting the wings. The device is very strong and simple, and is adapted to be secured to wagon or sled bolsters to strengthen them and form convenient stays for the load.

VEHICLE BRAKE MECHANISM.—James B. Upton, Coalfield, Tenn. A spring attachment is, according to this invention, connected with the vehicle in such a way that when the brake is applied in going down hill the spring is wound up and held wound, means being also provided for releasing the spring at any necessary time, so that its stored power can be utilized to start the vehicle or help carry it over a hill.

BOUTONNIERE.—Henry W. Fishel, New York City. The buttonhole stud has at its outer end a perforated socket in which is held an artificial flower, a split pin extending through the leaves or petals of the flower and through the perforations in the socket. The device is readily attached to or detached from the buttonhole of a garment, and it is so made that only the flower is visible on the exterior of the garment.

GARMENT FITTING PATTERN.—Simon Christiansen, New York City. This pattern is formed of a series of plates of leather, fabric, paper or other suitable material, which readily conforms to the shape of a person to be measured for a dress. It is conveniently applicable to the person to be measured, and arranged to permit of cutting the material directly from the pattern after adjustment of the latter according to the wearer's body. The device can be used by dress and cloak makers, tailors and others, for measuring all kinds of garments and cutting the cloth to form a perfect fit.

COMBINED CANE AND SEAT.—Carl Eframson, 304 Fourth st. S., Minneapolis, Minn. Combined with hollow pivoted body sections adapted to open and close, and forming seat-supporting legs, are seat sections fitting snugly together and connected by a web or seat, a fastening device securing the closed seat sections to the tops of the pivoted sections, while an attached third leg braces the pivoted sections. In its most compact shape the device is substantially like an ordinary cane, but it may be quickly opened and spread out to form a convenient stool or seat.

BLOTTER.—William Meyer, New York City. This is a simple device or fastening for securing together two or more sheets of blotting paper, so that the sheets can be quickly inserted or removed. It consists of a spring metal blank having at one end inwardly bent spurs for fixed engagement with the upper side of the blotter and at the other end spring tongues bent reversely and projecting underneath.

Designs.

BUCKLE.—Dora Harrison, Lansing, Mich. A wire bent at its middle to form a rectangular loop has its ends extended as shanks forming the buckle points, while pivoted on the loop at the sides of the shanks is a U-shaped frame, on the outer portion of which the points rest.

INFLATED CUSHION.—Robert T. Varnum, New York City. This is a cushion with open center and inner and outer margins simulating the contour of an egg.

BADGE.—James R. Lee, Baltimore, Md. This is a mourning badge, having a central emblem-receiving panel bordered at the top and bottom by contrasting panels, the whole forming an ornamental framing for an emblem.

SPOON HANDLE.—Austin F. Jackson, Taunton, Mass. The leading feature of this design is a volute spiral scroll resembling a closely coiled feather, while just below it is a smooth panel having upon each side a scrolled border.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

COALS AND COKES IN WEST VIRGINIA. By William Seymour Edwards. Cincinnati: Robert Clarke & Co. 1892. Pp. 162. Price 75 cents.

The wonderfully pure coals of this region seem, in this pamphlet, to receive at last adequate attention. There is little question that the importance of this region as a coal-producing center is growing. This monograph will receive considerable appreciation from those interested in industrial fuel and gas coal.

ADVANCED BUILDING CONSTRUCTION. By the author of "Notes on Building Construction." London and New York: Longmans, Green & Co. 1892. Pp. ix, 239. Price $1.50.

In this work we again have a book adapted for students in the English University course. It presents, therefore, a very English view of structural features of buildings, and is, of course, confined in scope to the South Kensington examination.

SCIENTIFIC AMERICAN BUILDING EDITION.

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2. Plate in colors showing a residence at Armory Hill, Springfield, Mass. Two perspective views and floor plans. Mr. Francis R. Allen, architect, Boston, Mass. An excellent design.
3. A cottage at Brookline Hills, Mass., erected at a cost of $4,825 complete. Perspective views and floor plans. Messrs. Sheply, Rutan & Coolidge, architects, Boston. A picturesque design.
4. A dwelling erected at Holyoke, Mass., at a cost of $6,500. Floor plans, perspective, etc. Mr. G. P. B. Alderman, architect, same place.
5. A very attractive and convenient stable and carriage house erected at Plainfield, N. J., at a cost of $1,500 complete. Messrs. Rossiter & Wright, New York, architects.
6. A residence recently erected at Plainfield, N. J., at a cost of $9,175 complete. A picturesque design. Two perspective elevations and floor plans. Messrs. Rossiter & Wright, architects, New York.
7. An elegant residence recently erected at Malden, Mass., for Mr. B. G. Underwood. Two perspective views and floor plans, together with a view of the Holland stairway. Cost complete about $11,000. Mr. Frank L. Smith, architect, Boston.
8. A substantial residence at Holyoke, Mass. Perspective elevation and floor plans. Mr. H. H. Gridley, architect, Springfield, Mass. An excellent design.
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The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4; Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(4645) F. D. B. asks: How many elements are known to chemists at the present day? What metals are lighter than water? Give the distance in light years of a few of the stars that have had their parallax measured. A. There are about 70 elements recognized by chemists at the present time. Lithium, potassium and sodium are lighter than water. Distance in light years:

a Aurigæ (Capella)	10 to 70
a Canis Major (Sirius)	11 to 16
a Canis Minor (Procyon)	26
a Bootes (Arcturus)	23 to 25
a Lyræ (Vega)	12 to 32

A light year is 63,000 times the distance of the earth from the sun. The double numbers refer to the work of different astronomers.

(4646) G. C. M. asks: What size wire shall I use to convey a current of electricity, E. M. F. 9 to 12 volts, 1 to 1·50 amperes, a distance of 25 to 30 feet? A. No. 20 Am. W. G. will carry the current named.

(4647) H. & T. ask: Is there a pneumatic tube between Paris and Berlin, and if so, for what purpose is it used, and with what speed does the car travel? A. There are pneumatic tubes in Paris for carrying letters, also in Berlin; but none between the two cities. The speed is about 20 miles per hour. Size of tube 2½ inches.

(4648) J. O. and others ask how to ink typewriter ribbons. A. Take vaseline (petrolatum) of high boiling point, melt it on a water bath or slow fire, and incorporate by constant stirring as much lamp black or powdered drop black as it will take up without becoming granular. If the fat remains in excess, the print is liable to have a greasy outline; if the color is in excess, the print will not be clear. Remove the mixture from the fire, and while it is cooling mix equal parts of petroleum, benzine and rectified oil of turpentine, in which dissolve the fatty ink, introduced in small portions by constant agitation. The volatile solvents should be in such quantity that the fluid ink is of the consistence of fresh oil paint. One secret of success lies in the proper application of the ink to the ribbon. Wind the ribbon on a piece of cardboard, spread on a table several layers of newspaper, then unwind the ribbon in such lengths as may be most convenient, and lay it flat on the paper. Apply the ink, after agitation, by means of a soft brush, and rub it well into the interstices of the ribbon with a tooth brush. Hardly any ink should remain visible on the surface. For colored inks use Prussian blue, red lead, etc., and especially the aniline colors.

Aniline black	½ oz.
Pure alcohol	15 "
Concentrated glycerine	15 "

Dissolve the aniline black in the alcohol and add the glycerine. Ink as before. From the "Scientific American Cyclopedia of Receipts, Notes and Queries."

(4649) J. P. B. asks: How narrow a belt will a four horse power engine run and develop all the power there is in the engine (steam or gasoline), also what number horse power steam or gasoline engine would be equal to three good (true pulling) horses in a sweep or lever power? A. The power transmitted by a belt depends upon its speed as well as width. A 2 inch belt running 1,700 feet per minute will transmit 4 horse power. A 3 inch belt for the same power should run 1,100 feet per minute. As the actual horse power of steam and other engines, or prime movers, is based on the actual mean pulling power of fairly strong horses, 3 horse power actual of a steam or gas engine should be equal to the pull of 3 good horses. The nominal horse power of a steam engine is only a partial indication of its actual or indicated horse power, which depends upon the steam pressure and point of cut-off. In a gas engine the nominal horse power is not far from the indicated horse power, as the explosive pressures in a gas engine do not vary as much as the steam pressures in the steam engine.

(4650) M. S. K. writes: A friend says that a man weighs more at the equator than at the north pole, owing to the increase of gravity as the equator is approached. I say that the weight would be less at the equator, owing to the centrifugal force of the earth. Please let us know which is correct and what the variation per pound would be. A. Your friend is on the wrong side and you are correct.

(4651) E. V. wishes to know the life and how many shots can be fired from the 124 ton gun to be exhibited by Krupp at the World's Fair. What is the cause of disablement of so large a gun as the above after a number of rounds? A. The number of shots that a 124 ton gun can bear is very uncertain, depending upon the size of the bore and the powder charge. About 95 shots is all a 110 ton gun can usually stand.

(4652) O. D. R. asks: What is the difference in the power necessary to perform a certain amount of work with the usual piston, link and crank and with the power applied tangentially to a crank of the same radius? In what ratio does the resistance of air increase with compression? A. The crank value of the piston mean pressure is 62½ percent of the tangent force of the crank pin periphery. Volumes×15—15 is the approximate equation for compressing air (isothermally) for pressure. Thus 3 cubic feet compressed to 1 cubic foot is 3×15—15=30 pounds pressure. When air is suddenly compressed the heat generated by compression expands the air, and if confined reaches a higher pressure, which on cooling returns to the pressure as above stated. Complete tables of pressures, volumes and temperature, with the theory, may be found in SCIENTIFIC AMERICAN SPPULEMENT, No. 279, 10 cents mailed.

(4653) C. A. G. writes: In a letter of the 13th century it is related that some Greenland fishermen on the 25th of July, 1266, were in a place where "the sun was shining both nights and days, and was as high at midnight as it used to be when seen northwest of their home," the home being situated at 63° 10′ N. lat., and the time for the observation there the summer solstice. Is it possible to calculate the latitude of the unknown place, where they were on the above said day? A. The sun in the northwest at 63° of latitude at the summer solstice was probably 5° or 6° above the horizon. A midnight sun of that elevation on July 25 would require the fishing party to be in latitude 78° or 79°. No exact computation can be made from the statement given.

(4654) G. H. asks: Which is the largest and best shipyard where a man can get a job as carpenter, and what are the average wages for carpenters? A. The largest and most active shipyards are at Newport News, Va., Philadelphia, Chester, Pa., Wilmington, Del., and Bath, Maine. Ship carpenters' wages, $3 to $3.50 for first class workmen.

(4655) X. Y. asks: Is there an acid or spirit that by placing on ordinary glassware will soften it, so I can bore holes in it with a common awl? Please give some directions for use. A. No substance will soften glass. Heat is the only means of softening. You can drill a hole with a diamond or with emery in a small tube by revolving the tube.

(4656) P. G. asks: How fast can a man of ordinary strength row a sixteen foot boat containing one person besides himself? Also how large ought the propeller of a sixteen foot boat be, and how many revolutions must it make to drive the boat five miles an hour? A. One man can row a light shell boat from 5 to 5½ miles per hour. It will require a 12 inch diameter wheel, 2 feet pitch, 250 revolutions per minute to make 5 miles per hour.

(4657) Subscriber in Sweden asks: What is it to vulcanize railway sleepers, what way is it done, and what preparation is used for the purpose? A. The ties or other lumber are placed in strong cylinders of steel 6 feet diameter by about 50 feet in length, the cylinders being lined with coils of steam pipe. The cylinders are then closed tight and air pumped in until a pressure of about 150 pounds per square inch is obtained, when steam is turned into the coils at 200 pounds pressure per square inch and the heat due to this pressure kept up for from 4 to 5 hours, when the steam is turned off, air pressure discharged and the ties or lumber withdrawn. By the continued high heat under a pressure to prevent the sap boiling out of the wood the sap is thoroughly coagulated and the lumber dried. By this treatment lumber for interior work and furniture, and many kinds of wood heretofore rejected on account of liability to warp have become valuable for furniture and in decorative art work. The life of railway ties is largely lengthened by this process.

(4658) C. S. K. asks if the tension in a clock spring increases by winding the same amount as a spring in spring scales by pulling. A. The action of a spring in a clock increases its tension in winding the same as the spring in a balance by pulling, only the clock spring has so much longer range, with only a part of it in use, that the difference is not felt in winding.

(4659) E. B.—Zinc has the greatest degree of expansion and contraction by changes in temperature of the common metals. Mercury expands and contracts more than any metal and is therefore generally used in thermometers.

(4660) S. H. W.—Malleable iron can be nickel plated.

TO INVENTORS.

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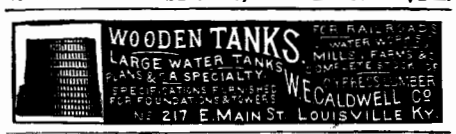
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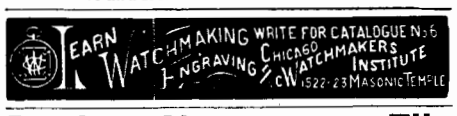

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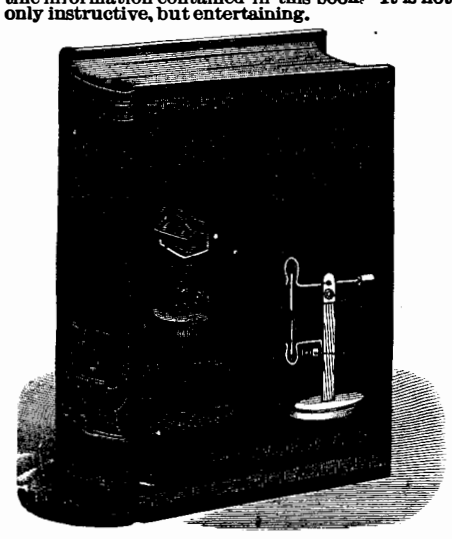

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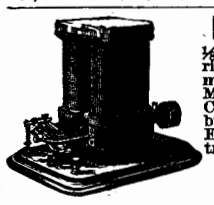

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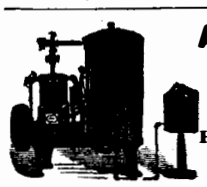

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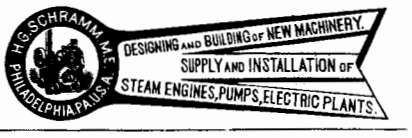
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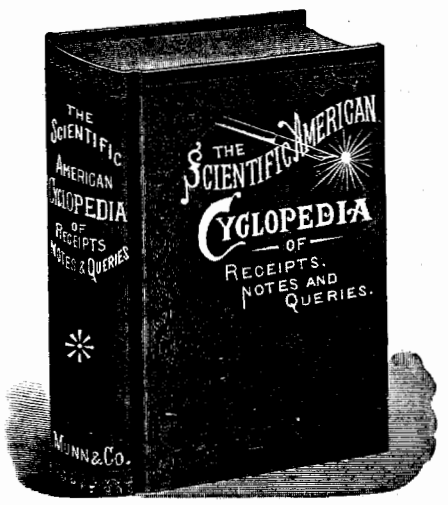

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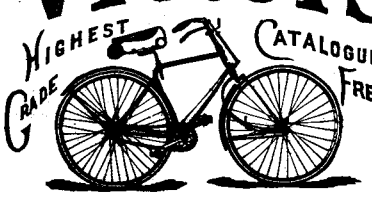

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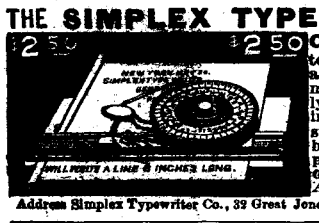

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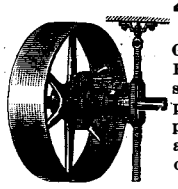

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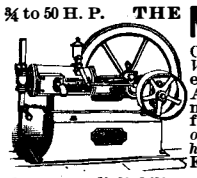

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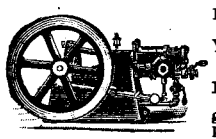

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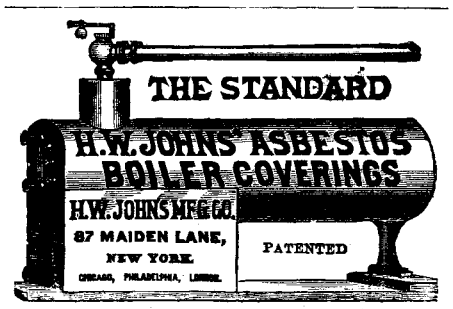

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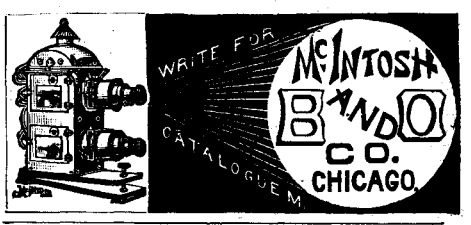

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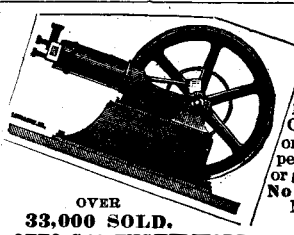

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